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**CUSTOMER DEDICATED FACILITIES AND INVENTORY SHARING IN INTEGRATED NETWORK DESIGN AND INVENTORY OPTIMIZATION**

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# CUSTOMER DEDICATED FACILITIES AND INVENTORY SHARING IN INTEGRATED NETWORK DESIGN AND INVENTORY OPTIMIZATION

by

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# CUSTOMER DEDICATED FACILITIES AND INVENTORY SHARING IN INTEGRATED NETWORK DESIGN AND INVENTORY OPTIMIZATION

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Shrinking profit margins in the high technology industry has led companies to attempt to increase profits through an increased focus on after-market services. As part of that effort, service parts logistics, which manages the post-sales distribution of spare parts needed to maintain and repair products in use, has gained importance. In an effort to improve Service Parts Logistics (SPL) operations, we integrate facility location and inventory stocking decisions while classifying facilities based on their assignment; dedicated facilities that are assigned solely to individual customers (located on-site of the customer, serving only that customer), and shared facilities that are assigned to a subset of customers.

The introduction of dedicated facilities simplifies the overall problem formulation in certain special cases. In one such special case where there is only one facility and none of the customers are within its service time window, the overall problem reduces to a binary knapsack formulation. This can be solved in pseudo-polynomial time through the

dynamic programming algorithm for such problems. Nonetheless, even in the general case, we identify conditions under which a dedicated facility will always be opened. Computational results show that this observation is used by solvers as a preprocessing step, thus loosening some hard constraints. As a result, some of these problems are solved in less time than the corresponding problems without the dedicated facilities. However, dedicated facilities become advantageous mainly in sparse networks as opposed to dense networks. Apart from low network density, low holding cost and relatively high demand are two other system parameters that encourage the opening of dedicated facilities.

SPL can be further improved by sharing inventory across shared facilities, which is already a common practice in real SPL systems. In this case, Markov chains can be used to estimate fill rates, but the process is iterative. However, under the low demand assumption of parts in SPL, we derive analytical formulae of estimating fill rates and thus incorporate inventory sharing within the network design and inventory optimization model. Special cases of this problem can be solved by an alternative binary knapsack formulation. Computational results show that large instances can be solved instantaneously, and we also identify a greedy heuristic that provides bounds on average within 0.12% of the optimal solution. We observe maximum benefit from inventory sharing when there exists large demand in the area overlapping the time window of both shared facilities and when inventory replenishment rates are high. However, we also identify conditions on the system parameters where inventory sharing could increase cost and/or decrease service in comparison with not-sharing.

The combined problem of inventory sharing with customer dedicated facilities is formulated based on a binary knapsack structure. However, the problem size increases exponentially with solution time. Therefore, we construct another greedy heuristic by combining the inventory sharing heuristic and a special case algorithm for a single dedicated facility. A large size problem that takes almost a minute to be solved by conventional branch and bound is solved in less than a second using the greedy heuristic. We also show that for a given demand network, the combined problem achieves 40-60% reduction in total cost within 1% of the time taken by the problem without inventory sharing and without dedicated facilities. Another interesting result is that in some cases, adding new customers to a given inventory sharing system helps to reduce the cost and/or increase service.

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# Chapter 1: Introduction

Responding to pressures from competition to keep shrinking profit margins under control is a major effort in any industry today, but it is especially true in the high technology industry. The high-tech manufacturers experiencing diminishing profit margins from product sales emphasize after-sales service as one area to increase revenues and profits, keep existing customers loyal and attract new customers who may have experienced service problems with other manufacturers.

In a survey study, the Aberdeen group (2005) reported that profit margins for aftermarket service and parts range from 25% to 1000% higher than margins for initial products. In this study, three quarters of the companies recognized that effective service parts logistics (SPL) is critical to the company's success. This study also reported that the SPL software application market accounted for approximately $105 million in 2005 with a growth rate of 20%.

Even from a profit point of view, the supply of aftermarket parts is a $400 billion business, and many of the Fortune 100 companies rely on the aftermarket service for up to 40% of their profits (Gallagher et al. (2005)). Another research study indicated that customers will spend five to 20 times the initial sales price on subsequent services and consumables (AMR Research (2002)).

The Aberdeen group (2005) also identified six primary areas affected by SPL:

i. Service parts planning
ii. Service parts forecasting
iii. Inventory management
iv. Service parts pricing
v. Service contract management/design
vi. Service parts execution and analytics

In this dissertation, we approach SPL from a strategic point of view by primarily focusing on the first and third application areas, i.e., service parts planning and inventory management, respectively, not only because of the costs savings potential, but also the inherent interaction between these areas in SPL systems, which motivates our integrated approach at the two areas. In SPL systems, the customers do not worry about where a needed part is supplied from or whether the part is available at a specific location or not. The main concern is to have the customer's system up and running with the proper part within a short time window, usually measured in hours. Hence, as long as the company is able to deliver the part within the time window spelled out in the customer service contracts, service is deemed to be good. This is where the two areas of network planning and inventory stocking interact: The network must have at least one stocking location close to the customer (within the time window) and one of the locations must have at least one unit of the needed part.

Hence, the *location* of the service facilities is crucial in SPL planning as well as in determining the inventory levels. With fewer locations, the company could take advantage of inventory pooling, but the service level would go down because it would be harder to reach customers within the committed time windows. Therefore we will focus on an integrated network design and inventory optimization model in Chapter 2. Previous models have had only one type of facilities, called "shared": all stocking locations in the network serve more than one customer and the stock level available at the location can be used to satisfy the demand of all customers that are assigned to that location. In our model, we allow more than one type of facility, "dedicated" along with shared facilities: Dedicated facilities in fact represent stocking locations at customer sites. The stock available at a dedicated facility can only be used to serve demand from the respective customer on-site. As actual SPL systems already have stocking rooms co-located at select customer sites, this extension of the original models is more consistent from a practical point of view.

Another common practice in SPL is inventory sharing among close-by neighboring stocking locations. This is especially true when the main location responsible from satisfying a certain customer is out of stock and another facility close enough to the customer to be within the time window has the part in stock. This way, time-based service does not have to suffer due to unavailability of the stock at the main location. The overall effect of this is potential reduction in the system-wide inventory levels to provide a given target time-based service level. For example, in a case study on Saturn's after-market service, Cohen et al. (2000) reported that Saturn organized "pooling groups" for the purposes of inventory sharing. If a part is out of stock, the retailer may fulfill the order through a lateral transshipment from nearby Saturn retailers. This has helped Saturn to have the highest parts availability among all other car manufacturers, and Saturn customers are more loyal for repair services as compared to the industry average.

Although practiced heavily in real SPL systems, almost all the location, network design, and inventory models (integrated or otherwise, used in practice or proposed in the literature) in SPL systems do not incorporate inventory sharing as part of the process, hence models have room to be more precise and to actually obtain solutions that reflect the operational practice. In Chapter 3, we research the idea of inventory sharing between shared facilities. This should potentially decrease the overall inventory, but modeling this is an iterative process. For example, if facility A cannot satisfy demand of one of the customers assigned to it, then that customer could be satisfied by a direct shipment from another facility B. This may or may not count towards the overall customer service, depending on the time window considerations, but the reduction in inventory at facility B could adversely affect the customers of facility B if facility B runs out of that same part. Hence, the iterative process takes into account the potentially increased demand due to inventory sharing and potentially decreased fill rates of local customers, and the fill rates (local or due to inventory sharing) iteratively converge to their actual values. As the iterative process cannot be made part of a monolithic optimization model easily, we initially plan to formulate an analytic method of obtaining these optimal fill rates for given base stock levels.

The ultimate goal in this dissertation is to use the analytic formulae (from the third chapter) within the optimization model from Chapter 2 to allow inventory sharing in the overall decision process of designing the network and determining the stock levels, among shared and dedicated facilities. This is the topic of Chapter 4. We then compare the performance of the models in each of the chapters for a given demand network.

The research done for this dissertation contributes to the existing literature by formulating more general problems and identifying procedures to solve them and/or obtain bounds for them in much less time. In Chapter 2, we allow customers to have potential dedicated facilities on-site. Using this general formulation, we isolate special cases that provide insight into the problem. For example, we are able to study the benefit of risk pooling, and identify cases where complete centralization or complete decentralization are optimal. Similarly, in Chapter 3 we provide a framework to incorporate inventory sharing within the overall decision process. The first challenge here is fill rate estimation. Based on some theoretical results, the problem is formulated as a binary knapsack problem. Combining the results of Chapters 2 and 3, the problem with dedicated facilities and inventory sharing is also formulated based on a binary knapsack structure, and we identify a greedy heuristic that provides good upper bounds to the overall problem.

A comparison of the models in the literature and Chapter 4 using the same demand network shows that we can obtain better solutions in much less time using the model in Chapter 4.

# Chapter 2: Dedicated Facilities

This chapter extends the works of Candas and Kutanoglu (2007a) as well as Jeet (2006) by allowing different types of facilities to be installed in the SPL network. In addition to the original facilities (now called shared facilities), some customers may have “dedicated facilities” on their own premises which are committed to them and are not (practically) permitted to stock-out. With this generalization, we identify special cases of this problem to help with the overall solution procedure. Finally, we perform a computational study to identify network parameters that favor dedicated facilities in the optimal solution. Furthermore, the introduction of dedicated facilities helps us analyze the benefits of risk pooling in SPL. Computational results show us that it is most often optimal to completely centralize or completely decentralize inventory.

## 1 Literature review

When dealing with service parts, the physical locations of stocking facilities relative to the customer locations are crucial for efficient planning and inventory management. In service parts logistics, we encounter companies that have to setup stocking facilities across the country and hold spare parts inventory for existing customers. Customers have contracts with the company that require the stocking facilities to serve them within a given time window.

Cohen et al. (2002) report that in the North American computer industry, many companies face multiple market segments with very different perceptions of service criticality. At one extreme, there are corporate customers who are willing to pay a good price for on-site, same day service to maintain their mission critical computer systems. At the other extreme are consumers who do not mind a three day waiting period and are not willing to pay a very high price for service. With the introduction of dedicated facilities, each customer in the network could be satisfied in one of two ways; either from a shared facility along with many other customers, or from an on-site, dedicated facility.

As such, critical customers with high service level requirements have the option of being served by dedicated facilities.

The problem of interest is to identify a subset of feasible locations where dedicated facilities need to be installed, as well as a subset of other feasible locations where shared facilities need to be installed. Along with facility location and allocation decisions, we also need to assign (base) stock levels at each facility to maintain an overall service level. The objective is to minimize the total facility installation cost, transportation cost, and inventory holding cost.

A review of the literature includes papers by Nozick (2001), Nozick and Turnquist (2001), Daskin et al. (2002), and Barnhart and Cohn (2002). However, all these papers model the fill-rate-based service level as a parameter, whereas Candas and Kutanoglu (2007a) as well as Jeet (2006) allow each facility to have its own fill rate variable such that the overall required (or target) time-based service level is satisfied. All the above papers assume only one type of facility.

However, there are many cases in which companies may prefer to have a variety of facilities. Facilities can be classified based on product differentiation, sales volume, and service capabilities. In the field of environmental engineering and policy studies, decision makers have an option between choosing facilities with different technological capabilities. In such cases, Harkness and Revelle (2002) formulate the basic capacitated facility location problem with mixed facilities having different cost and operating profiles based on a staircase cost structure. After formulating the problem as a mixed integer program, they adapt general Lagrangian relaxation techniques for solving the problem.

Similarly, Curtin and Church (2006) solve the problem of dispersing nuclear power plants and fossil fuel power plants such that security is maximized. Therefore, facilities are classified based on the source of power generation but they include constraints on the feasibility of locating both types of facilities at the same location. For example, if both power plants were located in the same location, then a military strike against one location may cripple both power plants simultaneously. Performance metrics now include competitive market advantage and security. The computational results show that in a problem with 25 facility locations, instances with more than five types of facilities can take more than 10,000 seconds. Both Harkness and Revelle (2002) and Curtin and Church (2006) do not include inventory decisions in their problem formulations.

We extend the works of Candas and Kutanoglu (2007a) and Jeet (2006) to allow multi-type facilities. This proposition is very practical since companies focusing on after-market service have high-priority customers, and these customers could benefit from service outlets (dedicated facilities) located on their own premises. Nevertheless, although we have multiple types of facilities in this problem, it is realistic to assume that if a dedicated facility is installed at a specific customer location, then this dedicated facility needs to dedicate all of its service only to that customer, and the customer can be served only by this dedicated facility for a specific part. Moreover, if a dedicated facility is installed, it is stocked in such a way that it does not stock out (has the parts that the customer needs) to provide truly high service level associated with having the stocking room on-site.

In Section 2 of this chapter, we model and analyze the integrated network design and inventory optimization problem with time-based service level constraints, but even after using an approximation scheme for the nonlinear fill rate function, large scale problems are not tractable even for a single part. This provides the motivation to look for special cases of these models that could be solved efficiently (Section 3). Next, we use computational results to identify network parameters that encourage the opening of dedicated facilities in Section 4. Finally in Section 5, we study the benefits of risk pooling by looking at a special case of the original problem.

## 2 Integrated problem with dedicated facilities

In this section, we model the integrated network design and inventory optimization problem for a single part.

### 2.1 Notation/Assumptions

Let $I$ be the set of facilities and $J$ be the set of customers. The set of facilities $I$ is given by $I = I' \cup I''$ where $I'$ is the set of dedicated facilities (indexed by $i'$) at customer locations ($I' \subseteq J$), and $I''$ is the set of shared facilities (indexed by $i''$) at customer locations as well as other locations. The decision variables can be defined as follows: let $Y_i$ be a binary variable such that $Y_i = 1$ if facility $i$ is chosen to be opened, and 0 otherwise, and let $X_{i''j}$ be another binary variable such that $X_{i''j} = 1$ if customer $j$'s demand is satisfied by shared facility $i''$, and 0 otherwise. For each facility $i$, $f_i$ denotes the fixed cost of opening and operating the facility (per unit time, say a week), and for each customer $j$, $d_j$ denotes the customer's mean demand rate per unit time ($d_j > 0\ \forall j$) for the part. Moreover, $c_{i''j}$ denotes the unit transportation cost from shared facility $i''$ to customer $j$, and $\delta_{i''j}$ is 1 if customer $j$ is within the time window of shared facility $i''$, i.e., facility $i''$ can deliver the part to customer $j$ within the time window (provided that the shared facility has the part in stock). We assume that dedicated facilities are always within the time window of the respective on-site customers and the cost of transportation in this case is negligible. Cost is directly proportional to the distance (closest shared facility is the cheapest in terms of transportation cost).

Customers can be grouped into customer-accounts such that each customer-account has its own service level. This enables large corporations with multiple customer locations to be satisfied with some target service level based on contractual agreements. Suppose the set of customer-accounts $R$ is indexed by $r$. Then, let $\alpha_r$ be the target service level in customer-account $r$, which determines the minimum fraction of the total demand in customer account $r$ that needs to be satisfied within the time window. Assuming that every customer belongs to exactly one customer-account, we now have a set $J_r$, which represents the set of customers that belong to customer-account $r$ $\left( J = \bigcup_{r \in R} J_r \right)$.

If a customer is assigned to a shared facility, then this facility should have a positive stock level. We also assume that whenever customer demand cannot be satisfied by the assigned shared facility, it is satisfied by a direct shipment from the central warehouse (CW). The central warehouse has infinite supply of inventory, and it is already installed (no fixed cost). None of the customers are within the time window of the central warehouse. In this chapter we assume that there is no direct shipment cost from the central warehouse to customers. However, customers cannot be "assigned" to the central warehouse. (This assumption will be relaxed in some special case problems).

### 2.2 **Formulation with dedicated facilities**

As a first step, we begin by formulating the service level constraint. The service level constraint formulation depends upon the distribution of the demand process. When dealing with service parts, customer demand is almost always exactly one unit. This is because the probability of more than one part failing at the same time is effectively zero. Therefore, it is safe to assume that demand occurs according to a Poisson process, which is also very common in service parts literature (see, for example, Muckstadt (2005), which is now a reference source in this area).

Suppose $D \sim Poisson(\lambda)$ is the demand satisfied within the time window, and $\tilde{D} \sim Poisson(\tilde{\lambda})$ is the demand satisfied after the time window. The long run probability that demand is satisfied within the time window is $E\left(\frac{D}{D+\tilde{D}}\right) = \frac{E(D)}{E(D+\tilde{D})}$ since demand follows a Poisson distribution. The service level requirement states that at least $\alpha$ % of the demand should be satisfied within the time window, i.e. $\frac{E(D)}{E(D+\tilde{D})}$ $= \frac{E(D)}{E(D)+E(\tilde{D})} \geq \alpha$.

The numerator can be calculated as $E(D) = \sum_{\substack{i' \in I', \\ j \in J \\ i' = j}} d_j Y_{i'} + \sum_{i'' \in I''} \sum_{j \in J_r} \delta_{i''j} d_j X_{i''j}$ because the demand satisfied by dedicated facilities is always within the time window, and the rest of the demand may or may not be satisfied within the time window based on the parameters $\delta_{ij}$'s. Since we assume that all demand has to be satisfied, the denominator is $E(D) + E(\tilde{D}) = \sum_{j \in J} d_j$ .

Based on the above formulae, the service level constraint for a single customer-account is given by

$$\sum_{\substack{i' \in I', \\ j \in J \\ i' = j}} d_j Y_{i'} + \sum_{i'' \in I''} \sum_{j \in J} \delta_{i''j} d_j X_{i''j} \geq \alpha \sum_{j \in J} d_j \tag{2.1}$$

We can now formulate the overall network design optimization problem (NDP) with multiple customer-accounts (ignoring the inventory decisions for now) as follows:

**P$_1$:** Minimize

$$\sum_{i' \in I'} f_{i'} Y_{i'} + \sum_{i'' \in I''} f_{i''} Y_{i''} + \sum_{i'' \in I''} \sum_{j \in J} c_{i''j} d_j X_{i''j} \tag{2.2a}$$

subject to

$$Y_{i'} + \sum_{i'' \in I''} X_{i''j} = 1 \quad \forall j \in I' \tag{2.2b}$$

$$\sum_{i'' \in I''} X_{i''j} = 1 \quad \forall j \in J \setminus I' \tag{2.2c}$$

$$X_{i''j} \le Y_{i''} \quad \forall i'' \in I'', j \in J \tag{2.2d}$$

$$\sum_{\substack{i' \in I', \\ j \in J_r \\ i' = j}} d_j Y_{i'} + \sum_{i'' \in I''} \sum_{j \in J_r} \delta_{i''j} d_j X_{i''j} \ge \alpha_r \sum_{j \in J_r} d_j \quad \forall r \in R \tag{2.2e}$$

$$X_{i''j} \in \{0,1\} \quad \forall i'' \in I'', j \in J \tag{2.2f}$$

$$Y_{i'} \in \{0,1\} \quad \forall i' \in I' \tag{2.2g}$$

$$Y_{i''} \in \{0,1\} \quad \forall i'' \in I''. \tag{2.2h}$$

The first term in the objective function is the fixed cost of opening dedicated facilities, followed by the fixed cost of opening shared facilities and the transportation cost of allocating customers to shared facilities. It is not necessary to calculate the transportation cost of allocating customers to dedicated facilities because they both are in the same location (assuming transportation cost is negligible). Constraint (2.2b) assigns a customer having a potential dedicated facility on-site either to itself (opening a dedicated facility) or to another shared facility, and constraint (2.2c) assigns the rest of the customers to shared facilities. Constraint (2.2d) forces a shared facility to be open if customers are allocated to it, and constraint (2.2e) ensures that the total assigned demand satisfies the target service level in each customer-account. The rest are binary constraints.

The main economic tradeoff in the above model is between the fixed cost of opening facilities and the cost of transporting parts to the customer. If we incorporate inventory decisions into the NDP model, we encounter another tradeoff, between holding cost of inventory and fill rate within the time window. If we open more facilities and stock them with parts, then more customers will be served within the time window. On the other hand, we can take advantage of inventory pooling by opening and stocking fewer facilities, but customers would be farther away, and fewer customers would be served within the time window. Therefore, another motivation of including inventory decisions in the model is to benefit from inventory pooling opportunities.

We now begin formulating the NDP problem with inventory (NDIP). As mentioned earlier, demand can be modeled as a Poisson process. Suppose $t_{i''}$ is the lead time for replenishment at shared facility $i''$. Then the mean demand during lead time at shared facility $i''$ is given by

$$\lambda_{i''} = t_{i''} \sum_{j \in J} d_j X_{i''j} \quad \forall i'' \in I''. \tag{2.3}$$

There are two new decision variables $S_{i''}$ and $\beta_{i''}$ for each shared facility $i''$, where $S_{i''}$ denotes the base stock level and $\beta_{i''}$ is the corresponding fill rate at shared facility $i''$.

As mentioned earlier, whenever a shared facility stocks-out for a customer's demand, the customer is served by a direct delivery from the central warehouse, but it is considered to be a case of lost sales for the shared facility under consideration, and does not count towards the target service level. With this assumption, the fill rate is a nonlinear function of the mean demand during lead time and the base stock level as follows:

$$\beta_{i''}\left(S_{i''}, \lambda_{i''}\right) = 1 - \frac{\dfrac{\lambda_{i''}^{S_{i''}}}{S_{i''}!}}{\displaystyle\sum_{k=0}^{S_{i''}} \frac{\lambda_{i''}^{k}}{k!}} \quad \forall i'' \in I'', \tag{2.4}$$

where $\frac{\frac{\lambda_{i''}^{S_{i''}}}{S_{i''}!}}{\sum_{k=0}^{S_{i''}} \frac{\lambda_{i''}^{k}}{k!}}$ is the Erlang blocking formula. The Erlang blocking formula gives us the long run probability of stocking out in a continuous time Markov chain where each state corresponds to the on-hand inventory level at shared facility $i''$ (Zipkin (2000)).

Note that we do not need base stock level variables and fill rate variables for dedicated facilities. This is because of the assumption we made that dedicated facilities should provide practically 100% service to their respective customers. Moreover, due to the low demand rate characteristic of customers in the service parts industry, this could be further simplified to say that a stock of one unit is always sufficient for essentially 100% service (at that customer location). Figure 1 shows that when mean lead time demand is up to 0.01 units, a base stock level of one unit provides 100% service for all practical purposes. Therefore, the open/close location variable of dedicated facilities ($Y_{i'}$) additionally serves as the fill rate variable as well as the base stock level variable.

We mentioned previously that the service level requirement states that at least $\alpha$ % of the total demand should be satisfied within the time window, i.e. $\frac{E(D)}{E(D)+E(\tilde{D})} \geq \alpha$ where the denominator is $E(D)+E(\tilde{D}) = \sum_{j \in J} d_j$. Now that shared facilities are allowed to stockout, the service level constraint has to include part availability (or fill rate).

In order to estimate the numerator, suppose $D_i \sim Poisson(\lambda_i)$ is the demand during the lead time that is satisfied within the time window at facility *i* and $Z_i$ is the on-hand inventory level at facility *i*. By linearity of expectation, $E(D) = \sum_{i \in I} E(D_i)$. Using the "law of total probability for expectations" on the numerator, $\sum_{i \in I} E(D_i) =$ $\sum_{i \in I} E(D_i \mid Z_i = 0)P(Z_i = 0) + E(D_i \mid Z_i > 0)P(Z_i > 0)$, the first term of which is equal to 0. Therefore, $E(D) = \sum_{i \in I} E(D_i) = \sum_{i \in I} E(D_i \mid Z_i > 0)P(Z_i > 0) \quad = \sum_{i \in I} E(D_i)\beta_i$. As a result, $E(D) = \sum_{i' \in I'} E(D_{i'})Y_{i'} + \sum_{i'' \in I''} E(D_{i''})\beta_{i''}$ since $Y_{i'}$ serves as the fill rate variable for dedicated facilities. The service level constraint for a single customer-account with Poisson demand is given by

$$\sum_{\substack{i' \in I', \\ j \in J \\ i' = j}} d_j Y_{i'} + \sum_{i'' \in I''} \beta_{i''} \sum_{j \in J} \delta_{i''j} d_j X_{i''j} \geq \alpha \sum_{j \in J} d_j \quad . \tag{2.5}$$

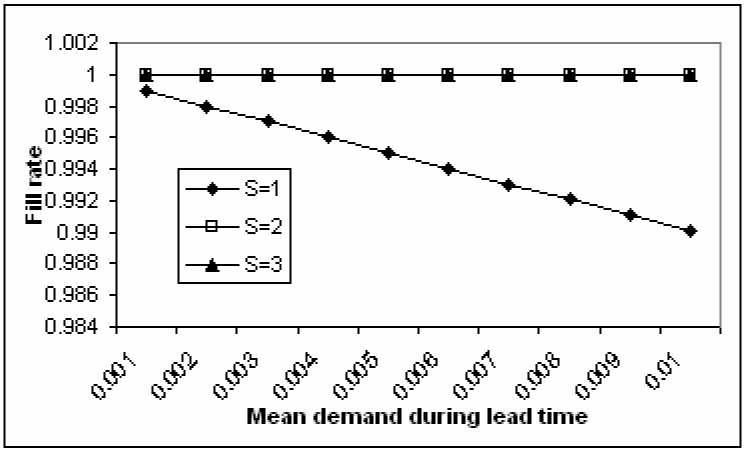



Figure 1. Fill rate function

Suppose $h_i$ is the unit holding cost per unit time at facility $i$. We can now formulate the NDIP problem by adding equations (2.3) and (2.4) to $\mathbf{P_1}$, replacing constraint (2.2e) with equation (2.5), and simultaneously modifying the objective function.

**$\mathbf{P_2}$:** Minimize

$$\sum_{i' \in I'} (f_{i'} + h_{i'}) Y_{i'} + \sum_{i'' \in I''} (f_{i''} Y_{i''} + h_{i''} S_{i''}) + \sum_{i'' \in I''} \sum_{j \in J} c_{i''j} d_j X_{i''j} \tag{2.6a}$$

subject to

$$Y_{i'} + \sum_{i'' \in I''} X_{i''j} = 1 \quad \forall j \in I' \tag{2.6b}$$

$$\sum_{i'' \in I''} X_{i''j} = 1 \quad \forall j \in J \setminus I' \tag{2.6c}$$

$$X_{i''j} \le Y_{i''} \quad \forall i'' \in I'', j \in J \tag{2.6d}$$

$$\lambda_{i''} = t_{i''} \sum_{j \in J} d_j X_{i''j} \quad \forall i'' \in I'' \tag{2.6e}$$

$$\beta_{i''} = 1 - \frac{\dfrac{\lambda_{i''}^{S_{i''}}}{S_{i''}!}}{\displaystyle\sum_{k=0}^{S_{i''}} \frac{\lambda_{i''}^{k}}{k!}} \quad \forall i'' \in I'' \tag{2.6f}$$

$$S_{i''} \le s_{\max} Y_{i''} \quad \forall i'' \in I'' \tag{2.6g}$$

$$\sum_{\substack{i'\in I',\\ j\in J_r\\ i'=j}} d_j Y_{i'} + \sum_{i''\in I''} \beta_{i''} \sum_{j\in J_r} \delta_{i''j} d_j X_{i''j} \geq \alpha_r \sum_{j\in J_r} d_j \quad \forall r\in R \tag{2.6h}$$

$$Y_{i''} \leq S_{i''} \quad \forall i''\in I'', j\in J \tag{2.6i}$$

$$X_{i''j} \in \{0,1\} \quad \forall i''\in I'', j\in J \tag{2.6j}$$

$$Y_{i'} \in \{0,1\} \quad \forall i'\in I' \tag{2.6k}$$

$$Y_{i''} \in \{0,1\} \quad \forall i''\in I'' \tag{2.6l}$$

$$S_{i''} \in \overline{S} \quad \forall i''\in I'' \tag{2.6m}$$

$$\lambda_{i''} \geq 0 \quad \forall i''\in I'' \tag{2.6n}$$

$$\beta_{i''} \geq 0 \quad \forall i''\in I'', \tag{2.6o}$$

where $\overline{S} = \{0,1,2,\ldots,s_{\max}\}$ is the set of feasible base stock levels.

Since the location variable of dedicated facilities also represents the base stock level, the fixed cost and holding cost of dedicated facilities are combined in the first term of the objective function. The only other change in the objective function is the inclusion of the holding costs at shared facilities. Constraints (2.6b), (2.6c), and (2.6d) are the same as those in the NDP formulation. The new inventory constraints (2.6e) and (2.6f) calculate the mean demand during lead time at each shared facility and the corresponding fill rate, respectively. Constraint (2.6g) ensures that shared facilities can be stocked only if they are opened, and no more than $s_{\max}$ units of inventory can be stocked at any shared facility. A generalized version of equation (2.5) for multiple customer-accounts is given in constraint (2.6h), and constraint (2.6i) forces each opened shared facility to be stocked with at least one unit. Constraints (2.6j) through (2.6o) are non-negativity and integrality constraints.

We can manipulate the above NDIP formulation to obtain special cases of this problem. The problem solved by Candas and Kutanoglu (2007a) and Jeet (2006) is a special case with no dedicated facilities ($I'$=Ø), and with a system-wide service level

$(|R| = 1 \text{ and } J_1 = J)$. Another special case is where each customer is a customer-account by itself and has its own target service level $(R = J \text{ and } J_j = \{j\})$, collectively called customer-centric service levels (Candas and Kutanoglu (2007b)).

An important theoretical result is that there are certain conditions in which a dedicated facility will always be open in any optimal solution. However, we cannot make any statements about the conditions when a dedicated facility will be closed in any optimal solution because regardless of the parameters in the problem, a dedicated facility may always have to be opened to satisfy the service level constraint.

**Theorem 2.1.** *Dedicated facility $i'$ is open in any optimal solution if* $f_{i'} + h_{i'} \le \min_{i''}\{c_{i''i'}d_{i'}\}$.

**Proof**: Suppose all shared facilities are already open. Then dedicated facility $i'$ is opened only if the total cost of opening and holding inventory is less than the transportation cost and the marginal inventory holding cost $(\bar{h}_{i''})$ at the closest shared facility:

$$f_{i'} + h_{i'} \le c_{i''i'}d_{i'} + \bar{h}_{i''},$$

since $\bar{h}_{i''} \ge 0 \ \forall i'' \in I''$, and $f_{i'} + h_{i'} \le c_{i''i'}d_{i'} \le \min_{i''}\{c_{i''i'}d_{i'}\}$. ■

Since the main focus of this chapter is to identify theoretical results and derive intuitions about the problem as opposed to finding better ways to solve the problem, we adapt a previously developed formulation by Jeet (2006) where special ordered sets of type 2 variables (sos2) are used in the approximation of the fill rate function. During the progress of this research, there have been improvements in the formulation where a better lower bounding approach is used to solve the problem and sos2 variables need not be used anymore (Jeet (2006)). However, all the results in this chapter are based on the sos2 variable formulation (Appendix A).

## 3 Special cases

In this section, we identify special cases of the NDIP based on the number of shared facilities as well as some other special cases based on the number of customer-accounts.

### 3.1 Special cases based on the number of shared facilities

The NDIP problem can be partitioned into four cases; no shared facilities among multiple dedicated facilities, only one shared facility among multiple dedicated facilities, multiple shared facilities among multiple dedicated facilities, and all shared facilities with no dedicated facilities. In each of these cases, parameters such as the fixed cost ( $f_i$ ) and the holding cost ( $h_i$ ) can be varied to identify potentially easy problems. Table 1 shows sub-cases under each partition as well as the computational complexity of the problem.

Table 1. Special cases based on the number of shared facilities

<table>
<tr><th>Case</th><th>Sub-case</th><th>Complexity</th><th>Problem type</th></tr>
<tr><td>No shared facilities<br>( $|I'| \geq 0, |I''| = 0$ )</td><td>Allow customers to be assigned to CW</td><td>Weakly NP-Hard</td><td>Binary knapsack</td></tr>
<tr><td>One shared facility<br>( $|I'| \geq 0, |I''| = 1$ )</td><td>$I' = J$<br>$f_{i'} = 0 \ \forall i', f_{i''} = 0 \ \forall i''$,<br>$h_{i'} = h \ \forall i', h_{i''} = h \ \forall i''$<br>$d_j = d \ \forall j, c_{i''j} = c \ \forall j, \delta_{i''j} = 1 \ \forall j$<br>Allow customers to be assigned to CW</td><td>Trivial</td><td></td></tr>
<tr><td rowspan="2">Multiple shared facilities<br>( $|I'| \geq 0, |I''| \geq 0$ )</td><td>$f_{i'} = 0 \ \forall i', f_{i''} = 0 \ \forall i''$,<br>$h_{i'} = 0 \ \forall i', h_{i''} = 0 \ \forall i''$</td><td>Trivial</td><td></td></tr>
<tr><td>$f_{i'} \geq 0 \ \forall i', f_{i''} \geq 0 \ \forall i''$,<br>$h_{i'} = 0 \ \forall i', h_{i''} = 0 \ \forall i''$</td><td>Strongly NP-Hard</td><td>NDP</td></tr>
<tr><td rowspan="2">All shared facilities<br>( $|I'| = 0, |I''| \geq 0$ )</td><td>$f_{i''} = 0 \ \forall i'', h_{i''} = 0 \ \forall i''$</td><td>Trivial</td><td></td></tr>
<tr><td>$f_{i''} \geq 0 \ \forall i'', h_{i''} = 0 \ \forall i''$</td><td>Strongly NP-Hard</td><td>NDP</td></tr>
</table>

Note that an NP-Hard problem is "Weakly NP-Hard" if there exists a pseudo-polynomial time algorithm to solve the problem. On the other hand, if no such algorithm exists, then the problem is "Strongly NP-Hard".

***No shared facilities***

In the case where customers can be assigned to the central warehouse, the problem turns out to have a binary knapsack formulation for each customer-account. All those customers that do not have dedicated facilities are assigned to the central warehouse, thus reducing the set of customers to the set of customers with dedicated facilities $I'$. Also $X_{i'j}\ \ \forall j \in I'$ can be replaced by $(1 - Y_{i'})$. Since the central warehouse has infinite supply, and none of the customers are within the time window of the central warehouse, we eliminate the inventory decision variables completely from the model resulting in the following formulation in terms of the $Y_{i'}$ variables alone (for each customer-account *r*):

**P$_{2'}$:**Minimize

$$\sum_{\substack{i' \in I', \\ j \in J_r \\ i' = j}} (f_{i'} + h_{i'}) Y_{i'} \tag{2.6a$'$}$$

subject to

$$\sum_{\substack{i' \in I', \\ j \in J_r \\ i' = j}} d_j Y_{i'} \geq \alpha_r \sum_{j \in J_r} d_j \quad \forall r \in R \tag{2.6h$'$}$$

$$Y_{i'} \in \{0,1\} \quad \forall i' \in I'. \tag{2.6k$'$}$$

For each customer-account *r*, this is the binary knapsack formulation, by inspection. Those customers with $Y_{i'}^* = 0$ in the optimal solution are assigned to the central warehouse.

***One shared facility***

Allowing customers to be assigned to the central warehouse, the case with free fixed cost ($f_{i'} = 0 \ \forall i', f_{i''} = 0 \ \forall i''$), and constant values for holding cost, demand, and transportation cost ($h_{i'} = h \ \forall i', h_{i''} = h \ \forall i'', d_j = d \ \forall j, c_{i''j} = c \ \forall j$) is trivial when all customers are within the time window of the single shared facility. This special case is trivial because for a given stock level at the shared facility all the remaining variables are trivial. Therefore, this special case can be solved by simply evaluating the objective value at each level of stock at the shared facility. This special case is discussed in detail in Section 5.

***Multiple shared facilities***

In the case where $f_{i'} = 0$, $f_{i''} = 0$, $h_{i'} = 0$, and $h_{i''} = 0 \ \forall i' \in I', i'' \in I''$, the optimal solution is to open all dedicated facilities, assign each customer to its own dedicated facility, and stock each dedicated facility with $S_{i'} = 1$ unit. Open all shared facilities, and assign each remaining customer to the closest shared facility. Any feasible $\beta$ vector could be used to solve for $S_{i''}$. For example, we can set $\beta_{i''} = \max_{r \in R} \{\alpha_r\} \ \forall i'' \in I''$ and calculate the corresponding $S_{i''}$ values based on equation (2.4). As a result, this solution is trivial. The case with $h_{i'} = 0$, and $h_{i''} = 0 \ \forall i' \in I', i'' \in I''$ is basically the NDP problem which is NP-Hard.

***All shared facilities***

The case with $f_{i''} = 0$, and $h_{i''} = 0 \ \forall i'' \in I''$ is trivial. The solution is to open all shared facilities, and assign each customer to the closest shared facility. Any feasible $\beta$ vector could be used to solve for $S_{i''}$. The case with $h_{i''} = 0 \ \forall i'' \in I''$ is the NDP problem which is again NP-Hard.

In all the above cases, whenever holding cost is negligible, any $\beta$ vector satisfying constraint (2.6h) could be used to calculate the base stock level $S_{i''}$ because there is no motivation to decrease inventory. In the extreme case, we can set $\beta$ for each shared facility to be equal to the target service level. Another way to obtain a feasible $\beta$ vector is by sorting shared facilities in non-increasing order of assigned demand and assigning $\beta_{i''} = 1$ for each shared facility in this order until the target service level is achieved.

### 3.2 Special cases based on the number of customer accounts

Based on the number of customer accounts, the NDIP problem can be partitioned into three cases; system-wide service level, customer-account service levels, and customer-centric service levels. The customer-account service levels case is the general case. For the other two special cases, we now compare the relative complexity of the problems in Table 2.

Table 2. Special cases based on the number of customer accounts

| **Case** | **Sub-case** | **Complexity** | **Problem type** |
|---|---|---|---|
| System-wide service level ($\lvert R\rvert = 1$) | | Strongly NP-Hard | NDIP |
| Customer-centric service levels ($R = J$) | ($\lvert I'\rvert \geq 0, \lvert I''\rvert = 0$), Allow customers to be assigned to CW | Trivial | |
| | $\alpha_j = \alpha$ | Strongly NP-Hard | CFL |

***System-wide service level***

When there exists only one customer-account, we can modify the service level constraint as follows.

$$\sum_{\substack{i'\in I',\\ j\in J\\ i'=j}} d_j Y_{i'} + \sum_{i''\in I''} \beta_{i''} \sum_{j\in J} \delta_{i''j} d_j X_{i''j} \geq \alpha \sum_{j\in J} d_j \tag{2.7}$$

Replacing constraint (2.6h) with equation (2.7) as the service level constraint, we can solve the NDIP problem with a system-wide service level.

***Customer-centric service levels***

Suppose $\alpha_j$ is the target service level for customer *j*, the $d_j$ term drops out from both sides of the service level constraint resulting in the following equations as the modified service level constraints:

$$Y_{i'} + \sum_{i'' \in I''} \beta_{i''} \delta_{i''j} X_{i''j} \geq \alpha_j \quad \forall j \in I', \tag{2.8}$$

$$\sum_{i'' \in I''} \beta_{i''} \delta_{i''j} X_{i''j} \geq \alpha_j \quad \forall j \in J \setminus I'. \tag{2.9}$$

In the case where $|I'| \geq 0, |I''| = 0$, and we allow customers to be assigned to the central warehouse, the binary knapsack formulation $\mathbf{P_{2'}}$ becomes trivial because the $d_j$ term drops out from both sides of constraint (2.6h′) resulting in the following formulation:

$\mathbf{P_{2''}}$**:** Minimize

$$\sum_{\substack{i' \in I', \\ j \in J_r \\ i' = j}} (f_{i'} + h_{i'}) Y_{i'} \tag{2.6a′′}$$

subject to

$$Y_{i'} \geq \alpha_j \quad \forall j \in I' \tag{2.6h′′}$$

$$Y_{i'} \in \{0,1\} \quad \forall i' \in I'. \tag{2.6k′′}$$

The solution is that for every $i'$ such that $\alpha_j = 0 \quad \forall j \in I'$ and $f_{i'} + h_{i'} > c_{i'j} d_j \quad \forall j \in I'$, we close dedicated facility $i'$. Otherwise, it is optimal to open dedicated facility $i'$.

Candas and Kutanoglu (2007b) formulate the NDIP problem with customer-centric service levels but without any dedicated facilities. Based on the critical observation that each customer has to be assigned to a shared facility that has a higher fill rate than the customer's target service level, they report that the problem formulation resembles a capacitated facility location (CFL) problem. If the assignment constraints are relaxed, the resulting subproblem decomposes by shared facility. In addition, if each customer has the same demand, then each subproblem reduces to a knapsack problem.

Appendix B shows their formulation modified to include dedicated facilities. This problem also resembles a CFL. By extending the observation made by Candas and Kutanoglu (2007b), if we relax both sets of assignment constraints (i.e. one set for customers with dedicated facilities, and the other set for the rest of the customers) then the resulting subproblem again decomposes by shared facility. When all customers have the same demand, the problem once again reduces to a knapsack problem with an additional set of variables for opening/closing dedicated facilities.

## 4 Computational results

Consider a 10 shared facility, 50 customer service parts network in a circular region of diameter 100 units. Customer and shared facility locations are generated by randomly assigning polar coordinates for each customer and shared facility. Suppose there are five customer-accounts with 10 customers each, and let the time window for service be 30 units. In order to analyze the tradeoff between the benefit of opening dedicated facilities and the benefits of inventory pooling, let us also suppose that shared facilities are free to install. All costs are fixed and constant across facilities and customers except for transportation cost which depends on the physical locations of the customers and the facilities. We can now identify those parameters that contribute to the benefit of using dedicated facilities by running a design of experiments with the following factors.

- $f_{i'} = \{0, 0.2, 0.4\}$
- $h_i = \{0, 0.1, 0.2\}$
- $\alpha_r = \{0.6, 0.8\}$

- $d_j = \{0.005, 0.01\}$

Each of the 36 instances is replicated four times with no dedicated facilities ($\{|I'| = 0, |I''| = 10\}$), with half of the customer locations as potential dedicated facilities ($\{|I'| = 25, |I''| = 10\}$), with all the customer locations as potential dedicated facilities with no shared facilities ($\{|I'| = 50, |I''| = 0\}$), and with all customer locations as dedicated facilities and all shared facilities ($\{|I'| = 50, |I''| = 10\}$).

The formulation in Appendix A is used to obtain the computational results. As mentioned in Section 2.2, the formulation in Appendix A is a modification of the sos2 variable formulation by Jeet (2006). The modifications are listed as follows. First of all we generate a set of feasible dedicated facility locations among all the customer locations $(I')$, and then for every dedicated facility $i'$ we define a new set of variables $(Y_{i'})$, and we also estimate fixed cost $(f_{i'})$ and holding cost $(h_{i'})$ parameters.

The new objective function now has to reflect the relevant costs of dedicated facilities given by $\sum_{i' \in I'} (f_{i'} + h_{i'}) Y_{i'}$ which is added to the objective function.

In terms of constraint modification, we need a new set of assignment constraints that allows a customer to either be assigned to a dedicated facility (if there exists one on-site) or to a shared facility. Therefore, we add $Y_{i'} + \sum_{i'' \in I''} X_{i''j} = 1 \ \forall j \in I'$ to the set of constraints.

In addition, we need to assign 100% fill rate to all the demand satisfied by dedicated facilities. This is done by adding $\sum_{\substack{i' \in I', \\ j \in J_r \\ i' = j}} d_j Y_{i'}$ to the existing service level constraint. These modifications are sufficient to include dedicated facilities into the sos2 variable formulation by Jeet (2006). This modified sos2 formulation (Appendix A) is modeled in MOSEL and solved using Branch and bound with Xpress MP as the solver (provided by

Dash Optimization) using a Pentium 4 700 MHz processor with 1GB RAM, and the results are given in Table 3.

The input parameters are organized as follows.

- Fixed cost of opening a dedicated facility – denoted by "$f_{i'}$"
- Holding cost of inventory at each facility – denoted by "$h_i$"
- Target service level of each customer-account – denoted by "$\alpha_r$"
- Demand of each customer – denoted by "$d_j$"
- Percentage of customers with dedicated facilities $\left(\frac{|I'|}{50}\times 100\right)$ – denoted by "% ded"
- Percentage of shared facilities that are feasible to be opened and stocked $\left(\frac{|I''|}{10}\times 100\right)$ – denoted by "% shd"

The output is organized as follows.

- Number of dedicated facilities opened – denoted by "# ded"
- Number of shared facilities opened – denoted by "# shd"
- Units of inventory stocked at shared facilities – denoted by "s shd"
- Total cost – denoted by "Obj Val"
- Solution time – denoted by "Sol Time"
- Status of solution at termination – denoted by "Status"
- Number of branch and bound nodes at termination – denoted by "B&B nodes"
- Optimality gap at termination – denoted by "Opt Gap"

Table 3. Computational results – dedicated facilities

| | INPUT | | | | | | OUTPUT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp | $f_{i'}$ | $h_i$ | $\alpha$ | $d_j$ | % ded | % shd | # ded | # shd | s shd | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 1 | 0 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 10 | 50 | 3.275 | 11.02 | Opt | 108 | 0 |
| 2 | 0 | 0 | 0.6 | 0.005 | 50 | 100 | 25 | 9 | 45 | 1.731 | 5.368 | Opt | 12 | 0 |
| 3 | 0 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 0 | 0 | 0.2 | Opt | 1 | 0 |
| 4 | 0 | 0 | 0.6 | 0.005 | 100 | 100 | 50 | 0 | 0 | 0 | 0.281 | Opt | 1 | 0 |
| 5 | 0 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 10 | 50 | 6.55 | 16.49 | Opt | 337 | 0 |
| 6 | 0 | 0 | 0.6 | 0.01 | 50 | 100 | 25 | 9 | 45 | 3.462 | 5.468 | Opt | 14 | 0 |
| 7 | 0 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 0 | 0 | 0.261 | Opt | 1 | 0 |
| 8 | 0 | 0 | 0.6 | 0.01 | 100 | 100 | 50 | 0 | 0 | 0 | 0.28 | Opt | 1 | 0 |
| 9 | 0 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 10 | 50 | 3.275 | 14.96 | Opt | 280 | 0 |
| 10 | 0 | 0 | 0.8 | 0.005 | 50 | 100 | 25 | 9 | 45 | 1.731 | 4.997 | Opt | 21 | 0 |
| 11 | 0 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 0 | 0 | 0.22 | Opt | 1 | 0 |
| 12 | 0 | 0 | 0.8 | 0.005 | 100 | 100 | 50 | 0 | 0 | 0 | 0.301 | Opt | 1 | 0 |
| 13 | 0 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 10 | 50 | 6.55 | 8.862 | Opt | 69 | 0 |
| 14 | 0 | 0 | 0.8 | 0.01 | 50 | 100 | 25 | 9 | 45 | 3.462 | 6.089 | Opt | 19 | 0 |
| 15 | 0 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 0 | 0 | 0.211 | Opt | 1 | 0 |
| 16 | 0 | 0 | 0.8 | 0.01 | 100 | 100 | 50 | 0 | 0 | 0 | 0.29 | Opt | 1 | 0 |
| 17 | 0 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.098 | 6.81 | Opt | 26 | 0 |
| 18 | 0 | 0.1 | 0.6 | 0.005 | 50 | 100 | 4 | 7 | 7 | 3.957 | 7.711 | Opt | 29 | 0 |
| 19 | 0 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 0 | 5 | 0.21 | Opt | 1 | 0 |
| 20 | 0 | 0.1 | 0.6 | 0.005 | 100 | 100 | 11 | 7 | 7 | 3.662 | 6.059 | Opt | 16 | 0 |
| 21 | 0 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 8 | 7.448 | 11.47 | Opt | 84 | 0 |
| 22 | 0 | 0.1 | 0.6 | 0.01 | 50 | 100 | 14 | 8 | 8 | 6.445 | 2.693 | Opt | 7 | 0 |
| 23 | 0 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 0 | 5 | 0.221 | Opt | 1 | 0 |
| 24 | 0 | 0.1 | 0.6 | 0.01 | 100 | 100 | 31 | 4 | 4 | 4.728 | 3.385 | Opt | 23 | 0 |
| 25 | 0 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.098 | 12.32 | Opt | 141 | 0 |
| 26 | 0 | 0.1 | 0.8 | 0.005 | 50 | 100 | 4 | 7 | 7 | 3.957 | 8.653 | Opt | 60 | 0 |
| 27 | 0 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 0 | 5 | 0.22 | Opt | 1 | 0 |
| 28 | 0 | 0.1 | 0.8 | 0.005 | 100 | 100 | 11 | 7 | 7 | 3.662 | 6.9 | Opt | 34 | 0 |
| 29 | 0 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 8 | 7.448 | 10.9 | Opt | 105 | 0 |
| 30 | 0 | 0.1 | 0.8 | 0.01 | 50 | 100 | 14 | 8 | 8 | 6.446 | 5.788 | Opt | 5 | 0 |
| 31 | 0 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 0 | 5 | 0.22 | Opt | 1 | 0 |
| 32 | 0 | 0.1 | 0.8 | 0.01 | 100 | 100 | 31 | 4 | 4 | 4.728 | 2.944 | Opt | 1 | 0 |
| 33 | 0 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.798 | 4.596 | Opt | 10 | 0 |
| 34 | 0 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 7 | 7 | 4.798 | 7.091 | Opt | 6 | 0 |
| 35 | 0 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 0 | 10 | 0.23 | Opt | 1 | 0 |
| 36 | 0 | 0.2 | 0.6 | 0.005 | 100 | 100 | 0 | 7 | 7 | 4.798 | 10.83 | Opt | 105 | 0 |
| 37 | 0 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 7 | 7 | 8.196 | 11.45 | Opt | 61 | 0 |
| 38 | 0 | 0.2 | 0.6 | 0.01 | 50 | 100 | 4 | 7 | 7 | 7.915 | 9.494 | Opt | 70 | 0 |
| 39 | 0 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 0 | 10 | 0.23 | Opt | 1 | 0 |
| 40 | 0 | 0.2 | 0.6 | 0.01 | 100 | 100 | 11 | 7 | 7 | 7.323 | 6.559 | Opt | 58 | 0 |
| 41 | 0 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.798 | 8.302 | Opt | 73 | 0 |
| 42 | 0 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 7 | 7 | 4.798 | 12.59 | Opt | 123 | 0 |
| 43 | 0 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 0 | 10 | 0.23 | Opt | 1 | 0 |
| 44 | 0 | 0.2 | 0.8 | 0.005 | 100 | 100 | 0 | 7 | 7 | 4.798 | 13.37 | Opt | 64 | 0 |
| 45 | 0 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 7 | 7 | 8.196 | 11.65 | Opt | 105 | 0 |
| 46 | 0 | 0.2 | 0.8 | 0.01 | 50 | 100 | 4 | 7 | 7 | 7.915 | 12.3 | Opt | 111 | 0 |
| 47 | 0 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 0 | 10 | 0.22 | Opt | 1 | 0 |
| 48 | 0 | 0.2 | 0.8 | 0.01 | 100 | 100 | 11 | 7 | 7 | 7.323 | 13.41 | Opt | 166 | 0 |

| | INPUT | | | | | | OUTPUT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp | $f_{i'}$ | $h_i$ | $\alpha$ | $d_j$ | % ded | % shd | # ded | # shd | s shd | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 49 | 0.2 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 10 | 50 | 3.275 | 10.29 | Opt | 108 | 0 |
| 50 | 0.2 | 0 | 0.6 | 0.005 | 50 | 100 | 0 | 10 | 50 | 3.275 | 8.472 | Opt | 43 | 0 |
| 51 | 0.2 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 0 | 10 | 0.221 | Opt | 1 | 0 |
| 52 | 0.2 | 0 | 0.6 | 0.005 | 100 | 100 | 0 | 10 | 50 | 3.275 | 9.924 | Opt | 50 | 0 |
| 53 | 0.2 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 10 | 50 | 6.55 | 16.41 | Opt | 337 | 0 |
| 54 | 0.2 | 0 | 0.6 | 0.01 | 50 | 100 | 4 | 10 | 50 | 6.276 | 13.59 | Opt | 209 | 0 |
| 55 | 0.2 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 0 | 10 | 0.23 | Opt | 1 | 0 |
| 56 | 0.2 | 0 | 0.6 | 0.01 | 100 | 100 | 10 | 10 | 50 | 5.817 | 9.184 | Opt | 65 | 0 |
| 57 | 0.2 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 10 | 50 | 3.275 | 14.73 | Opt | 280 | 0 |
| 58 | 0.2 | 0 | 0.8 | 0.005 | 50 | 100 | 0 | 10 | 50 | 3.275 | 8.402 | Opt | 44 | 0 |
| 59 | 0.2 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 0 | 10 | 0.23 | Opt | 1 | 0 |
| 60 | 0.2 | 0 | 0.8 | 0.005 | 100 | 100 | 0 | 10 | 50 | 3.275 | 10.93 | Opt | 79 | 0 |
| 61 | 0.2 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 10 | 50 | 6.55 | 9.173 | Opt | 69 | 0 |
| 62 | 0.2 | 0 | 0.8 | 0.01 | 50 | 100 | 4 | 10 | 50 | 6.276 | 9.804 | Opt | 48 | 0 |
| 63 | 0.2 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 0 | 10 | 0.241 | Opt | 1 | 0 |
| 64 | 0.2 | 0 | 0.8 | 0.01 | 100 | 100 | 10 | 10 | 50 | 5.817 | 12.54 | Opt | 262 | 0 |
| 65 | 0.2 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.098 | 6.589 | Opt | 26 | 0 |
| 66 | 0.2 | 0.1 | 0.6 | 0.005 | 50 | 100 | 0 | 7 | 7 | 4.098 | 7.291 | Opt | 56 | 0 |
| 67 | 0.2 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 0 | 15 | 0.23 | Opt | 1 | 0 |
| 68 | 0.2 | 0.1 | 0.6 | 0.005 | 100 | 100 | 0 | 7 | 7 | 4.098 | 6.419 | Opt | 5 | 0 |
| 69 | 0.2 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 8 | 7.448 | 10.69 | Opt | 84 | 0 |
| 70 | 0.2 | 0.1 | 0.6 | 0.01 | 50 | 100 | 1 | 8 | 8 | 7.43 | 9.333 | Opt | 70 | 0 |
| 71 | 0.2 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 0 | 15 | 0.241 | Opt | 1 | 0 |
| 72 | 0.2 | 0.1 | 0.6 | 0.01 | 100 | 100 | 3 | 7 | 7 | 7.354 | 9.193 | Opt | 95 | 0 |
| 73 | 0.2 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.098 | 11.28 | Opt | 141 | 0 |
| 74 | 0.2 | 0.1 | 0.8 | 0.005 | 50 | 100 | 0 | 7 | 7 | 4.098 | 9.293 | Opt | 79 | 0 |
| 75 | 0.2 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 0 | 15 | 0.24 | Opt | 1 | 0 |
| 76 | 0.2 | 0.1 | 0.8 | 0.005 | 100 | 100 | 0 | 7 | 7 | 4.098 | 6.84 | Opt | 19 | 0 |
| 77 | 0.2 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 8 | 7.448 | 10.33 | Opt | 105 | 0 |
| 78 | 0.2 | 0.1 | 0.8 | 0.01 | 50 | 100 | 1 | 8 | 8 | 7.43 | 12.53 | Opt | 141 | 0 |
| 79 | 0.2 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 0 | 15 | 0.26 | Opt | 1 | 0 |
| 80 | 0.2 | 0.1 | 0.8 | 0.01 | 100 | 100 | 3 | 7 | 7 | 7.354 | 9.233 | Opt | 49 | 0 |
| 81 | 0.2 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.798 | 4.587 | Opt | 10 | 0 |
| 82 | 0.2 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 7 | 7 | 4.798 | 6.239 | Opt | 6 | 0 |
| 83 | 0.2 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 0 | 20 | 0.24 | Opt | 1 | 0 |
| 84 | 0.2 | 0.2 | 0.6 | 0.005 | 100 | 100 | 0 | 7 | 7 | 4.798 | 9.153 | Opt | 92 | 0 |
| 85 | 0.2 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 7 | 7 | 8.196 | 9.184 | Opt | 61 | 0 |
| 86 | 0.2 | 0.2 | 0.6 | 0.01 | 50 | 100 | 0 | 7 | 7 | 8.196 | 11.67 | Opt | 139 | 0 |
| 87 | 0.2 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 0 | 20 | 0.251 | Opt | 1 | 0 |
| 88 | 0.2 | 0.2 | 0.6 | 0.01 | 100 | 100 | 0 | 7 | 7 | 8.196 | 10.24 | Opt | 78 | 0 |
| 89 | 0.2 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.798 | 7.11 | Opt | 73 | 0 |
| 90 | 0.2 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 7 | 7 | 4.798 | 10.43 | Opt | 123 | 0 |
| 91 | 0.2 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 0 | 20 | 0.25 | Opt | 1 | 0 |
| 92 | 0.2 | 0.2 | 0.8 | 0.005 | 100 | 100 | 0 | 7 | 7 | 4.798 | 12.07 | Opt | 145 | 0 |
| 93 | 0.2 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 7 | 7 | 8.196 | 10.75 | Opt | 105 | 0 |
| 94 | 0.2 | 0.2 | 0.8 | 0.01 | 50 | 100 | 0 | 7 | 7 | 8.196 | 7.962 | Opt | 53 | 0 |
| 95 | 0.2 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 0 | 20 | 0.25 | Opt | 1 | 0 |
| 96 | 0.2 | 0.2 | 0.8 | 0.01 | 100 | 100 | 0 | 7 | 7 | 8.196 | 10.03 | Opt | 129 | 0 |

| Exp | INPUT | | | | | | OUTPUT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $f_{i'}$ | $h_i$ | $\alpha$ | $d_j$ | % ded | % shd | # ded | # shd | s shd | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 97 | 0.4 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 10 | 50 | 3.275 | 9.744 | Opt | 108 | 0 |
| 98 | 0.4 | 0 | 0.6 | 0.005 | 50 | 100 | 0 | 10 | 50 | 3.275 | 7.992 | Opt | 43 | 0 |
| 99 | 0.4 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 0 | 20 | 0.31 | Opt | 1 | 0 |
| 100 | 0.4 | 0 | 0.6 | 0.005 | 100 | 100 | 0 | 10 | 50 | 3.275 | 11.19 | Opt | 246 | 0 |
| 101 | 0.4 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 10 | 50 | 6.55 | 15.81 | Opt | 337 | 0 |
| 102 | 0.4 | 0 | 0.6 | 0.01 | 50 | 100 | 0 | 10 | 50 | 6.55 | 6.92 | Opt | 36 | 0 |
| 103 | 0.4 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 0 | 20 | 0.261 | Opt | 1 | 0 |
| 104 | 0.4 | 0 | 0.6 | 0.01 | 100 | 100 | 0 | 10 | 50 | 6.55 | 8.262 | Opt | 35 | 0 |
| 105 | 0.4 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 10 | 50 | 3.275 | 14.26 | Opt | 280 | 0 |
| 106 | 0.4 | 0 | 0.8 | 0.005 | 50 | 100 | 0 | 10 | 50 | 3.275 | 7.821 | Opt | 44 | 0 |
| 107 | 0.4 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 0 | 20 | 0.261 | Opt | 1 | 0 |
| 108 | 0.4 | 0 | 0.8 | 0.005 | 100 | 100 | 0 | 10 | 50 | 3.275 | 11.3 | Opt | 127 | 0 |
| 109 | 0.4 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 10 | 50 | 6.55 | 8.452 | Opt | 69 | 0 |
| 110 | 0.4 | 0 | 0.8 | 0.01 | 50 | 100 | 0 | 10 | 50 | 6.55 | 10.6 | Opt | 282 | 0 |
| 111 | 0.4 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 0 | 20 | 0.271 | Opt | 1 | 0 |
| 112 | 0.4 | 0 | 0.8 | 0.01 | 100 | 100 | 0 | 10 | 50 | 6.55 | 10.5 | Opt | 211 | 0 |
| 113 | 0.4 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.098 | 6.619 | Opt | 26 | 0 |
| 114 | 0.4 | 0.1 | 0.6 | 0.005 | 50 | 100 | 0 | 7 | 7 | 4.098 | 7.59 | Opt | 56 | 0 |
| 115 | 0.4 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 0 | 25 | 0.271 | Opt | 1 | 0 |
| 116 | 0.4 | 0.1 | 0.6 | 0.005 | 100 | 100 | 0 | 7 | 7 | 4.098 | 6.639 | Opt | 5 | 0 |
| 117 | 0.4 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 8 | 7.448 | 10.97 | Opt | 84 | 0 |
| 118 | 0.4 | 0.1 | 0.6 | 0.01 | 50 | 100 | 0 | 8 | 8 | 7.448 | 11.31 | Opt | 189 | 0 |
| 119 | 0.4 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 0 | 25 | 0.271 | Opt | 1 | 0 |
| 120 | 0.4 | 0.1 | 0.6 | 0.01 | 100 | 100 | 0 | 8 | 8 | 7.448 | 12.06 | Opt | 122 | 0 |
| 121 | 0.4 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.098 | 11.42 | Opt | 141 | 0 |
| 122 | 0.4 | 0.1 | 0.8 | 0.005 | 50 | 100 | 0 | 7 | 7 | 4.098 | 9.473 | Opt | 79 | 0 |
| 123 | 0.4 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 0 | 25 | 0.261 | Opt | 1 | 0 |
| 124 | 0.4 | 0.1 | 0.8 | 0.005 | 100 | 100 | 0 | 7 | 7 | 4.098 | 7.1 | Opt | 19 | 0 |
| 125 | 0.4 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 8 | 7.448 | 10.39 | Opt | 105 | 0 |
| 126 | 0.4 | 0.1 | 0.8 | 0.01 | 50 | 100 | 0 | 8 | 8 | 7.448 | 9.163 | Opt | 85 | 0 |
| 127 | 0.4 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 0 | 25 | 0.281 | Opt | 1 | 0 |
| 128 | 0.4 | 0.1 | 0.8 | 0.01 | 100 | 100 | 0 | 8 | 8 | 7.448 | 10.83 | Opt | 130 | 0 |
| 129 | 0.4 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.798 | 4.687 | Opt | 10 | 0 |
| 130 | 0.4 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 7 | 7 | 4.798 | 6.379 | Opt | 6 | 0 |
| 131 | 0.4 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 0 | 30 | 0.271 | Opt | 1 | 0 |
| 132 | 0.4 | 0.2 | 0.6 | 0.005 | 100 | 100 | 0 | 7 | 7 | 4.798 | 9.473 | Opt | 92 | 0 |
| 133 | 0.4 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 7 | 7 | 8.196 | 9.504 | Opt | 61 | 0 |
| 134 | 0.4 | 0.2 | 0.6 | 0.01 | 50 | 100 | 0 | 7 | 7 | 8.196 | 7.901 | Opt | 15 | 0 |
| 135 | 0.4 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 0 | 30 | 0.281 | Opt | 1 | 0 |
| 136 | 0.4 | 0.2 | 0.6 | 0.01 | 100 | 100 | 0 | 7 | 7 | 8.196 | 10.04 | Opt | 43 | 0 |
| 137 | 0.4 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 7 | 4.798 | 7.431 | Opt | 73 | 0 |
| 138 | 0.4 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 7 | 7 | 4.798 | 10.7 | Opt | 123 | 0 |
| 139 | 0.4 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 0 | 30 | 0.291 | Opt | 1 | 0 |
| 140 | 0.4 | 0.2 | 0.8 | 0.005 | 100 | 100 | 0 | 7 | 7 | 4.798 | 12.62 | Opt | 145 | 0 |
| 141 | 0.4 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 7 | 7 | 8.196 | 11.12 | Opt | 105 | 0 |
| 142 | 0.4 | 0.2 | 0.8 | 0.01 | 50 | 100 | 0 | 7 | 7 | 8.196 | 8.712 | Opt | 53 | 0 |
| 143 | 0.4 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 0 | 30 | 0.291 | Opt | 1 | 0 |
| 144 | 0.4 | 0.2 | 0.8 | 0.01 | 100 | 100 | 0 | 7 | 7 | 8.196 | 9.453 | Opt | 70 | 0 |

As mentioned earlier, each set of four consecutive rows represents a single instance with varying number of shared and dedicated facilities. The first, second and fourth rows of each instance correspond to having 0%, 50%, and 100% dedicated facilities respectively. As expected, we notice that the objective function potentially increases (and never decreases) from the first to the second row and from the second to the fourth row. The third row is always solved instantaneously since each customer is assigned to the dedicated facility on-site.

Among the four major factors being considered in this DOE ($f_{i'}$, $h_i$, $\alpha_r$, and $d_j$), an overview of the results shows that that when fixed cost increases, fewer dedicated facilities are opened, and when holding cost increases, fewer dedicated facilities are opened (Figure 2). However, the effect of increasing fixed cost at dedicated facilities is analogous to increasing holding cost since they are summed up together in the objective function coefficient.

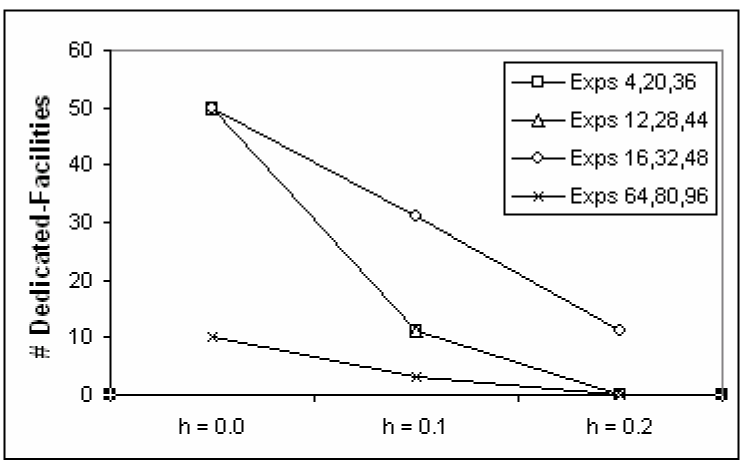



Figure 2. Effect of holding cost on the number of dedicated facilities opened

The effect of the target service level does not seem to be significant. In each of the 144 experimental settings, an increase in the target service level did not change the number of dedicated facilities opened. Note that we assume all customer-accounts have the same target service level to obtain comparable results across experiments.

On the other hand, demand seems to be the most significant factor in the number of opened dedicated facilities. Many more dedicated facilities are opened when customer demand is relatively high (Figure 3). Again, note that we assume all customers have the same demand rate. Initially we ran the experiments with demand varying across customers, but the results were comparable to the case with constant demand across all customers. Keeping the demand constant across all customers also helps to eliminate any unusual behavior in the results due to randomness.

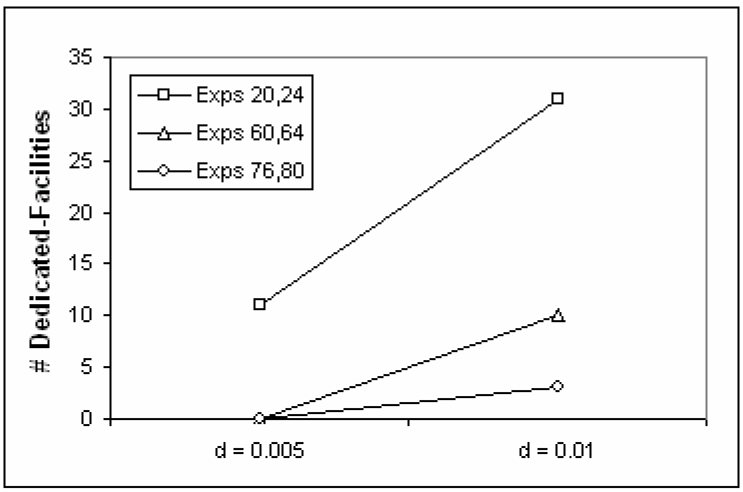



Figure 3. Effect of demand on the number of dedicated facilities opened

***Effect of network density***

Another important observation is that the benefit of the inclusion of dedicated facilities depends on the density of the network. Suppose we define the density of the network $(\rho)$ as the average number of customers within the time window of any given customer.

$$\rho = \frac{\sum_{j \in J} v_j}{n} \qquad (2.10)$$

where $\upsilon_j$ is the number of other customers within the time window of customer *j*. Figure 4 and Figure 5 show networks with low and high densities respectively, and green circles are drawn around those dedicated facilities that are opened in the optimal solution. These results correspond to experiment 56 in the DOE table.

The network in Figure 4 has a density of 18.72 customers. In this network, the optimal solution chooses 10 dedicated facilities. On the other hand, the network in Figure 5 has a density as high as 26.04 customers, and the optimal solution chooses only 4 dedicated facilities. This leads us to believe that dedicated facilities are more helpful in low density networks.

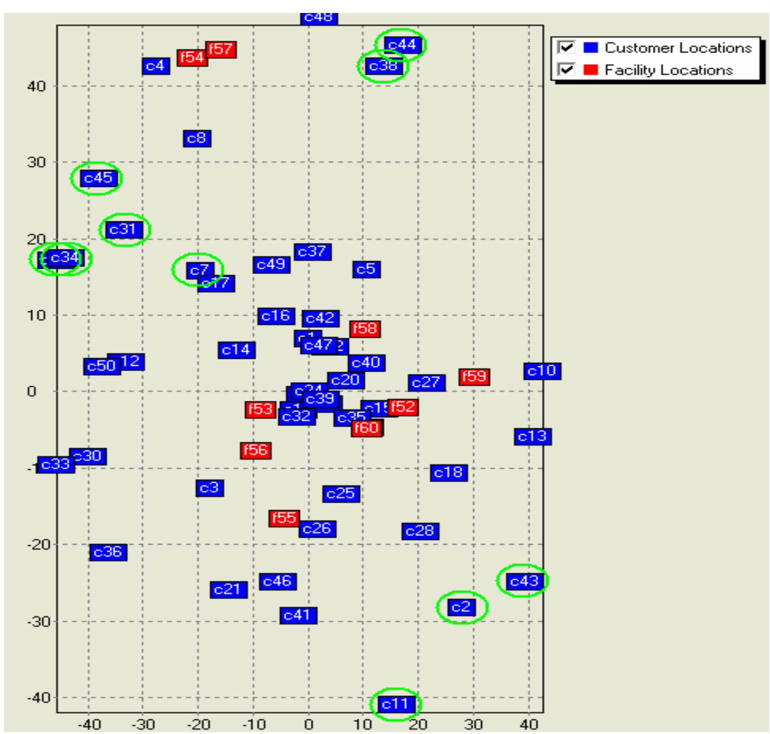



Figure 4. Low density network

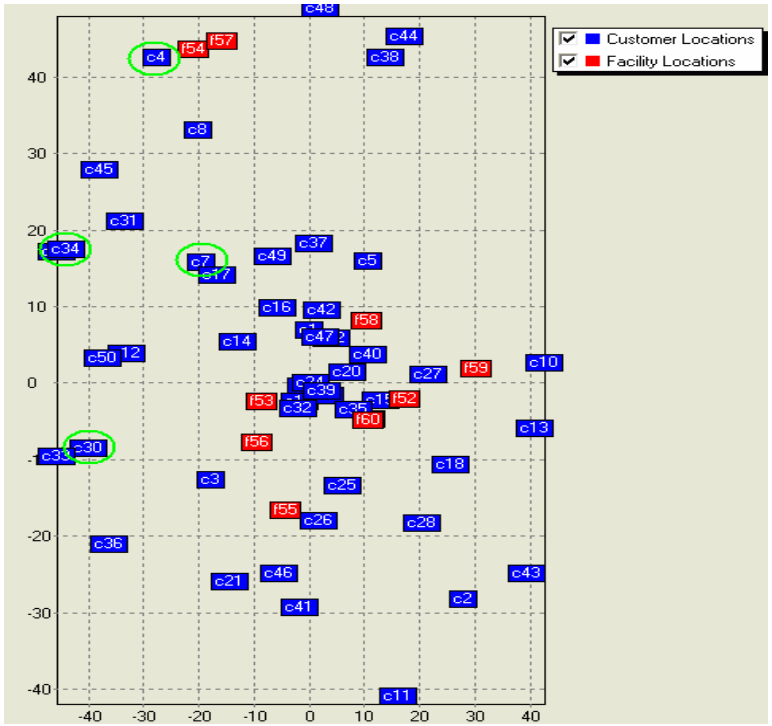



Figure 5. High density network

In order to test this hypothesis, we ran the DOE for the high density network. Appendix C shows the complete table of results. The optimal solution for the low density network had more dedicated facilities than that of the high density network in 20 out of 144 parameter combinations. We did not observe any cases where the optimal solution for the high density network chose to open more dedicated facilities than the corresponding low density network.

Therefore, in addition to low holding cost parameters and high demand values, low network density is another system parameter that encourages the opening of dedicated facilities.

***Improvement in solution time***

The inclusion of dedicated facilities in the decision making process can sometimes help reduce solution time as well. Figure 6 shows some cases in which this phenomena is observed.

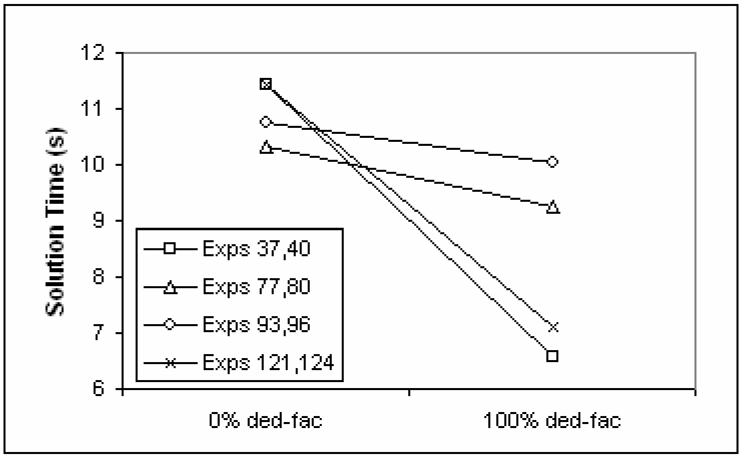



Figure 6. Effect of number of potential dedicated facility locations on solution time

This is primarily due to the result observed in Theorem 2.1. In a pre-processing step, the solver identifies those dedicated facilities that will have to remain open in any optimal solution, thus handling the part of the service level constraint in the preprocessing stage. As a result, the remaining problem is simplified and can be solved in less time.

***System-wide Vs Customer-centric service levels***

In order to gain more insight into problem, we ran two more scenarios of the problem while varying the number of customer-accounts. Experimental results with $|R| = 1$ and $R = J$ are given in Appendix D and Appendix E respectively.

As we vary customer-accounts, we notice that the customer centric model ($R = J$) always opens at least as many dedicated facilities as in the system-wide case ($|R| = 1$). The fact that dedicated facilities provide a 100% fill rate intuitively supports this result.

Another interesting result is that sometimes a dedicated facility is opened at a customer site although there exists an open and stocked shared facility within the time window. Figure 7 shows that a dedicated facility is opened on-site of customer ‘7’ although customer ‘7’ is only 22.04 time units away from opened and stocked shared facility ‘53’.

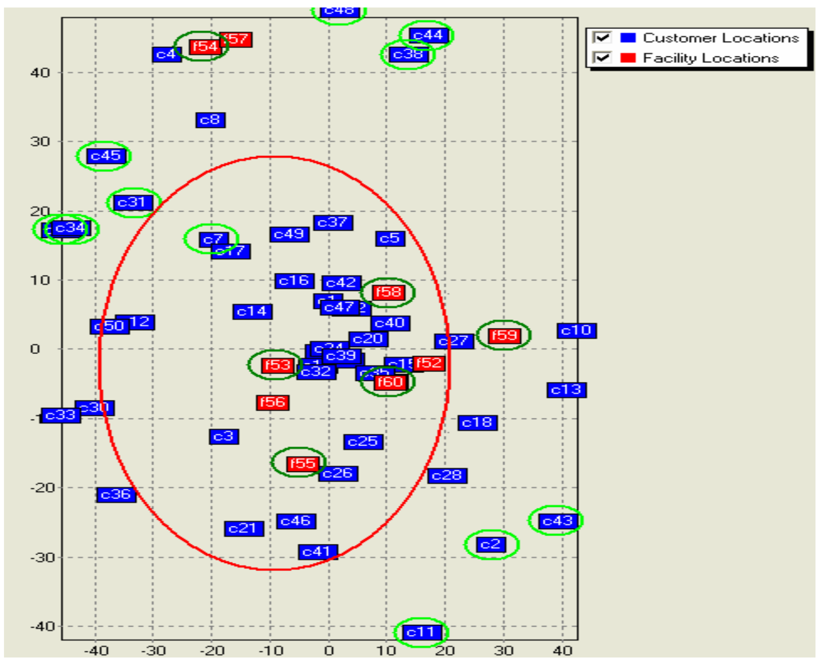



Figure 7. Dedicated facility opened within time window of an open shared facility

This could happen when the solver tries to avoid overshooting the service level constraint. In other words, if some other customer (not within the time window of an open and stocked shared facility) were to be assigned a dedicated facility, then this customer would have a 100% service, and customer ‘7’ will still have positive service, thus overshooting the target service level.

As a final step in this section, we ran a DOE to validate the first and second special cases in Table 1. The DOE results can be seen in Table 4 and Table 5.

Table 4. DOE results for first special case in Table 1

| INPUT | | | | OUTPUT | | | |
|---|---|---|---|---|---|---|---|
| $f_{i'}$ | $h_i$ | $\alpha$ | $d_j$ | # ded | Obj Val | Sol Time | Status |
| 0 | 0 | 0.6 | 0.005 | 50 | 0 | 1.592 | Opt |
| 0 | 0 | 0.6 | 0.01 | 50 | 0 | 0.06 | Opt |
| 0 | 0 | 0.8 | 0.005 | 50 | 0 | 0.06 | Opt |
| 0 | 0 | 0.8 | 0.01 | 50 | 0 | 0.07 | Opt |
| 0 | 0.1 | 0.6 | 0.005 | 30 | 3 | 0.11 | Opt |
| 0 | 0.1 | 0.6 | 0.01 | 30 | 3 | 0.08 | Opt |
| 0 | 0.1 | 0.8 | 0.005 | 40 | 4 | 0.081 | Opt |
| 0 | 0.1 | 0.8 | 0.01 | 40 | 4 | 0.08 | Opt |
| 0 | 0.2 | 0.6 | 0.005 | 30 | 6 | 0.08 | Opt |
| 0 | 0.2 | 0.6 | 0.01 | 30 | 6 | 0.08 | Opt |
| 0 | 0.2 | 0.8 | 0.005 | 40 | 8 | 0.08 | Opt |
| 0 | 0.2 | 0.8 | 0.01 | 40 | 8 | 0.08 | Opt |
| 0.2 | 0 | 0.6 | 0.005 | 30 | 6 | 0.08 | Opt |
| 0.2 | 0 | 0.6 | 0.01 | 30 | 6 | 0.07 | Opt |
| 0.2 | 0 | 0.8 | 0.005 | 40 | 8 | 0.07 | Opt |
| 0.2 | 0 | 0.8 | 0.01 | 40 | 8 | 0.061 | Opt |
| 0.2 | 0.1 | 0.6 | 0.005 | 30 | 9 | 0.07 | Opt |
| 0.2 | 0.1 | 0.6 | 0.01 | 30 | 9 | 0.07 | Opt |
| 0.2 | 0.1 | 0.8 | 0.005 | 40 | 12 | 0.08 | Opt |
| 0.2 | 0.1 | 0.8 | 0.01 | 40 | 12 | 0.07 | Opt |
| 0.2 | 0.2 | 0.6 | 0.005 | 30 | 12 | 0.07 | Opt |
| 0.2 | 0.2 | 0.6 | 0.01 | 30 | 12 | 0.07 | Opt |
| 0.2 | 0.2 | 0.8 | 0.005 | 40 | 16 | 0.07 | Opt |
| 0.2 | 0.2 | 0.8 | 0.01 | 40 | 16 | 0.07 | Opt |
| 0.4 | 0 | 0.6 | 0.005 | 30 | 12 | 0.07 | Opt |
| 0.4 | 0 | 0.6 | 0.01 | 30 | 12 | 0.071 | Opt |
| 0.4 | 0 | 0.8 | 0.005 | 40 | 16 | 0.07 | Opt |
| 0.4 | 0 | 0.8 | 0.01 | 40 | 16 | 0.07 | Opt |
| 0.4 | 0.1 | 0.6 | 0.005 | 30 | 15 | 0.06 | Opt |
| 0.4 | 0.1 | 0.6 | 0.01 | 30 | 15 | 0.07 | Opt |
| 0.4 | 0.1 | 0.8 | 0.005 | 40 | 20 | 0.07 | Opt |
| 0.4 | 0.1 | 0.8 | 0.01 | 40 | 20 | 0.07 | Opt |
| 0.4 | 0.2 | 0.6 | 0.005 | 30 | 18 | 0.07 | Opt |
| 0.4 | 0.2 | 0.6 | 0.01 | 30 | 18 | 0.07 | Opt |
| 0.4 | 0.2 | 0.8 | 0.005 | 40 | 24 | 0.071 | Opt |
| 0.4 | 0.2 | 0.8 | 0.01 | 40 | 24 | 0.07 | Opt |

Table 5. DOE results for second special case in Table 1

| INPUT | | | | OUTPUT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h_i$ | $c_{i''j}$ | $\alpha$ | $d_j$ | # ded | # shd | s ded | s shd | Fixed Cost | Transp Cost | Inv Cost | Obj Val | Sol Time | Status |
| 0 | 0 | 0.6 | 0.005 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.08 | Opt |
| 0 | 0 | 0.6 | 0.01 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.06 | Opt |
| 0 | 0 | 0.8 | 0.005 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.06 | Opt |
| 0 | 0 | 0.8 | 0.01 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.06 | Opt |
| 0 | 1 | 0.6 | 0.005 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.06 | Opt |
| 0 | 1 | 0.6 | 0.01 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.06 | Opt |
| 0 | 1 | 0.8 | 0.005 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.06 | Opt |
| 0 | 1 | 0.8 | 0.01 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.06 | Opt |
| 0 | 2 | 0.6 | 0.005 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.06 | Opt |
| 0 | 2 | 0.6 | 0.01 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.06 | Opt |
| 0 | 2 | 0.8 | 0.005 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.061 | Opt |
| 0 | 2 | 0.8 | 0.01 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.06 | Opt |
| 0.1 | 0 | 0.6 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0 | 0.1 | 0.1 | 0.07 | Opt |
| 0.1 | 0 | 0.6 | 0.01 | 0 | 1 | 0 | 1 | 0 | 0 | 0.1 | 0.1 | 0.07 | Opt |
| 0.1 | 0 | 0.8 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0 | 0.1 | 0.1 | 0.06 | Opt |
| 0.1 | 0 | 0.8 | 0.01 | 0 | 1 | 0 | 2 | 0 | 0 | 0.2 | 0.2 | 0.25 | Opt |
| 0.1 | 1 | 0.6 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0.25 | 0.1 | 0.35 | 0.08 | Opt |
| 0.1 | 1 | 0.6 | 0.01 | 0 | 1 | 0 | 1 | 0 | 0.5 | 0.1 | 0.6 | 0.081 | Opt |
| 0.1 | 1 | 0.8 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0.25 | 0.1 | 0.35 | 0.07 | Opt |
| 0.1 | 1 | 0.8 | 0.01 | 0 | 1 | 0 | 2 | 0 | 0.5 | 0.2 | 0.7 | 0.16 | Opt |
| 0.1 | 2 | 0.6 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0.5 | 0.1 | 0.6 | 0.08 | Opt |
| 0.1 | 2 | 0.6 | 0.01 | 0 | 1 | 0 | 1 | 0 | 1 | 0.1 | 1.1 | 0.11 | Opt |
| 0.1 | 2 | 0.8 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0.5 | 0.1 | 0.6 | 0.09 | Opt |
| 0.1 | 2 | 0.8 | 0.01 | 0 | 1 | 0 | 2 | 0 | 1 | 0.2 | 1.2 | 0.171 | Opt |
| 0.2 | 0 | 0.6 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0 | 0.2 | 0.2 | 0.08 | Opt |
| 0.2 | 0 | 0.6 | 0.01 | 0 | 1 | 0 | 1 | 0 | 0 | 0.2 | 0.2 | 0.08 | Opt |
| 0.2 | 0 | 0.8 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0 | 0.2 | 0.2 | 0.07 | Opt |
| 0.2 | 0 | 0.8 | 0.01 | 0 | 1 | 0 | 2 | 0 | 0 | 0.4 | 0.4 | 0.15 | Opt |
| 0.2 | 1 | 0.6 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0.25 | 0.2 | 0.45 | 0.08 | Opt |
| 0.2 | 1 | 0.6 | 0.01 | 0 | 1 | 0 | 1 | 0 | 0.5 | 0.2 | 0.7 | 0.08 | Opt |
| 0.2 | 1 | 0.8 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0.25 | 0.2 | 0.45 | 0.07 | Opt |
| 0.2 | 1 | 0.8 | 0.01 | 0 | 1 | 0 | 2 | 0 | 0.5 | 0.4 | 0.9 | 0.151 | Opt |
| 0.2 | 2 | 0.6 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0.5 | 0.2 | 0.7 | 0.08 | Opt |
| 0.2 | 2 | 0.6 | 0.01 | 0 | 1 | 0 | 1 | 0 | 1 | 0.2 | 1.2 | 0.08 | Opt |
| 0.2 | 2 | 0.8 | 0.005 | 0 | 1 | 0 | 1 | 0 | 0.5 | 0.2 | 0.7 | 0.08 | Opt |
| 0.2 | 2 | 0.8 | 0.01 | 0 | 1 | 0 | 2 | 0 | 1 | 0.4 | 1.4 | 0.16 | Opt |

From Table 4 and Table 5, we see that these problems are solved instantaneously. This supports the theoretical result in Table 1 that these special cases are significantly easier to solve than the general case. We mentioned earlier that the second special case is easy to solve. In the next section, we will explain this in detail.

## 5 Extension – benefit of risk pooling

The second special case in Table 1 can be used to assess the benefits of risk pooling in SPL. In this section, we formulate this special case and define conditions for which complete centralization and complete decentralization are optimal. Computational results show that the range of cost parameter values within which partial decentralization is optimal is very small. As a result, in most cases the optimal solution is either close to complete decentralization or close to complete centralization. Finally, we develop an algorithm that evaluates a small set of solutions that form an efficient frontier over the rest of the feasible solutions.

The general benefit of risk pooling has been extensively studied in the literature. Schwarz (1989) analyzes the benefit of risk pooling in terms of the lead time values for complete centralization versus complete decentralization. His main conclusion was that the degree of benefit of risk pooling is highly dependent on the pipeline inventory holding cost when inventory is completely centralized. As the pipeline inventory holding cost decreases, the benefit of risk pooling increases.

Xu and Evers (2003) prove that partial centralization can never be better than complete centralization based on demand correlation alone. However, transportation cost and lead times may favor partial centralization. Das and Tyagi (1997) develop an optimization model to analyze the optimal degree of centralization while balancing transportation and inventory costs.

In production-inventory systems, Kim and Benjaafar (2002) show that the benefit of pooling is sensitive to the utilization of the production system and the variability in demand and production times. Counter to intuition, the benefit of pooling is minimal when utilization of the production system is high and/or the variability in demand and production times is high.

Wong et al. (2005a) use Markov chains to obtain computational results on the benefits of pooling repairable service parts. Stocking decisions are then made by minimizing the inventory holding cost, downtime cost, and transshipment costs (Wong et al. (2005b)). In this section, we provide results similar to those of Das and Tyagi (1997), but in the context of service parts, in which demand is very low, inventory is replenished through a base stock policy, and a time-based service level must be satisfied.

### 5.1 **Notation/Assumptions**

As mentioned in Table 1, in this special case we assume that there exists one shared facility ($|I''| = 1$), and every customer is a potential dedicated facility ($I' = J$) and is within the time window of the shared facility ($\delta_{i''j} = 1 \ \forall j$). Each customer has a demand of $d$ units and is subject to a transportation cost of $c$ per unit demand (if assigned to the shared facility). The holding cost is $h$ at the shared and dedicated facilities. In order to isolate the effects of inventory cost and transportation cost on risk pooling, we assume that shared and dedicated facilities can be opened at no cost ($f_{i'} = 0 \ \forall i', f_{i''} = 0 \ \forall i''$). Furthermore, we allow all customers to be assigned to the central warehouse.

Let $N = \sum_{i' \in I'} Y_{i'}$ be the number of dedicated facilities to be opened, let $S = \sum_{i'' \in I''} S_{i''}$ be the (base) stock level at the shared facility (note that the set of shared facilities $I''$ has only one element), and let $n$ be the total number of customers. Since all customers are within the time window, we can write the service level constraint as

$$Nd + \beta(S,(n-N)d)(n-N)d \geq \alpha nd \qquad (2.6\text{h}''')$$

where $\lambda = (n-N)d$ is the mean demand during lead time at the shared facility when $N$ of the customers are served by dedicated facilities.

### 5.2 Reduced formulation

Assuming that capacity $s_{\max}$ is large enough to handle all the demand at the shared facility, we now formulate the optimization model as follows:

**P$_{2'''}$:** Minimize

$$z(N,S) = (n-N)cd + (N+S)h = (h-cd)N + hS + ncd \tag{2.6a$'''$}$$

subject to

$$N + \beta(S,(n-N)d)(n-N) \geq \alpha n \tag{2.6h$'''$}$$

$$N \in \{0,1,...,n\} \tag{2.6k$'''$}$$

$$S \in \{0,1,...,s_{\max}\}. \tag{2.6m$'$}$$

Dividing $z(N,S)$ by the constant $cd$, the proportional objective function is $\left(\frac{h}{cd}-1\right)N + \frac{h}{cd}S + nh$. Therefore, the value of ratio $h/cd$ plays a significant role in controlling the decision of centralization versus decentralization. Lower $h/cd$ values favor decentralization, whereas centralization becomes increasingly favorable as this ratio increases.

### 5.3 Theoretical results

An important observation is that the service level function for a fixed stock level is non-decreasing with respect to the number of dedicated facilities. In order to prove this, let us define $f(S,N) = N + \beta(S,(n-N)d)(n-N)$ as the left hand side of the constraint for given stock level *S* at the shared facility and number of dedicated facilities, *N*.

**Theorem 2.2**. *For a given value of S, f is a monotonically non-decreasing function in N, i.e.* $f(S,N+1) - f(S,N) \geq 0$.

**Proof**:

We have $f(S,N) = N + \beta(S,(n-N)d)(n-N)$ and

$$f(S, N+1) = (N+1) + \beta(S, (n-(N+1))d)(n-(N+1)).$$

Therefore,

$$\begin{aligned} f(S, N+1) - f(S, N) &= 1 + \beta(S, (n-N-1)d)(n-N-1) - \beta(S, (n-N)d)(n-N) \\ &= 1 + (n-N)(\beta(S, (n-N-1)d) - \beta(S, (n-N)d)) - \beta(S, (n-N-1)d) \end{aligned}$$

But for a given stock level $S$, fill rate increases as mean demand decreases. Hence,

$$(\beta(S, (n-N-1)d) - \beta(S, (n-N)d)) \geq 0.$$

Since $N \leq n$,

$$(n-N)(\beta(S, (n-N-1)d) - \beta(S, (n-N)d)) \geq 0.$$

Adding '1' to both sides,

$$1 + (n-N)(\beta(S, (n-N-1)d) - \beta(S, (n-N)d)) \geq 1.$$

Since the fill rate function is a proportion (between 0 and 1),

$$1 + (n-N)(\beta(S, (n-N-1)d) - \beta(S, (n-N)d)) - \beta(S, (n-N-1)d) \geq 0.$$

Hence, $f(S, N+1) - f(S, N) \geq 0$. ■

The implication of Theorem 2.2 is that for each stock level at the shared facility, we can now calculate the number of dedicated facilities required to satisfy the target service level (Corollary 2.1). Let $\overline{S}$ be the stock level required at the shared facility to satisfy the demand of all the customers while maintaining the target service level; $\overline{S} = \min_{S \in \{0,1,\ldots\}} \{S : \beta(S, nd) \geq \alpha\}$. The associated solution represents stocking $\overline{S}$ at the shared facility without any dedicated facilities, hence "complete centralization" with total cost of $h\overline{S} + ncd$. In comparison, suppose $S$ $(< \overline{S})$ units are stocked at the shared facility, let $\hat{N}_S$ be the smallest number of dedicated facilities that need to be opened in order to maintain the target service level, and let $\hat{\lambda}_S$ be the corresponding mean demand at the shared facility.

**Corollary 2.2.1.** For a given value of *S*, $\hat{N}_S = n - \lfloor \hat{\lambda}_S / d \rfloor$ where

$\hat{\lambda}_S = \max_{\lambda \le nd} \{\lambda : \lambda(1-\beta(S,\lambda)) \le nd(1-\alpha)\}$.

**Proof**:

By definition, $\lambda = (n-N)d$. Therefore, for a given value of *S*, $\hat{\lambda}_S = (n-\hat{N}_S)d$.

Rearranging the terms, the value of $\hat{N}_S$ is

$$\hat{N}_S = n - \left\lfloor \frac{\hat{\lambda}_S}{d} \right\rfloor$$

since $\hat{N}_S$ is defined as the smallest number of dedicated facilities that need to be opened.

Now, in order for equation (13) to be satisfied, we require

$$\hat{N}_S + \beta(S,(n-\hat{N}_S)d)(n-\hat{N}_S) \ge \alpha n .$$

Multiplying across by $-d$ and adding $nd$ to both sides,

$$nd - \hat{N}_S d - \beta(S,(n-\hat{N}_S)d)(n-\hat{N}_S)d \le nd - \alpha nd .$$

Substituting $\hat{\lambda}_S = (n-\hat{N}_S)d$,

$$\hat{\lambda}_S (1-\beta(S,\hat{\lambda}_S)) \le nd(1-\alpha).$$

Again, since $\hat{N}_S$ is defined as the smallest number of dedicated facilities that need to be opened, $\hat{\lambda}_S$ should be as large as possible. However, $\lambda \le nd$ is an upper bound on $\hat{\lambda}_S \; \forall S \in \{0,1,...,\bar{S}\}$. Therefore,

$$\hat{\lambda}_S = \max_{\lambda \le nd} \{\lambda : \lambda(1-\beta(S,\lambda)) \le nd(1-\alpha)\}. \blacksquare$$

For given system parameters $(\alpha, n, d)$, and cost parameters $(h, c)$, we now find conditions favoring centralization and decentralization.

**Theorem 2.3**. *Sufficient optimality conditions.*

(a) *Complete decentralization* $\left(S^* = 0, N^* = n\right)$ *is optimal if* $\frac{h}{cd} \le 1$.

(b) $\left(S^* = 0, N^* = \lceil \alpha n \rceil\right)$ *is optimal if* $1 < \frac{h}{cd} \le \min_{k \in \{1,2,\ldots,\overline{S}\}} \left\{ \frac{\lceil \alpha n \rceil - \hat{N}_k}{\lceil \alpha n \rceil - \hat{N}_k - k} \right\}$.

(c) *Complete centralization* $\left(S^* = \overline{S}, N^* = 0\right)$ *is optimal if*

$$\frac{h}{cd} \ge \max_{k \in \{0,1,\ldots,\overline{S}-1\}} \left\{ \frac{\hat{N}_k}{\hat{N}_k - \left(\overline{S} - k\right)} \right\}.$$

**Proof**:

(a) *Complete decentralization*:

The coefficient of $N$ in the objective function $z(N, S)$ is negative since $h - cd \le 0$. Therefore, the optimal solution is to set $S = 0$ and $N = n$.

(b) If $1 < \frac{h}{cd} \le \min_{k \in \{1,2,\ldots,\overline{S}\}} \left\{ \frac{\lceil \alpha n \rceil - \hat{N}_k}{\lceil \alpha n \rceil - \hat{N}_k - k} \right\}$, then for every $k \in \{1,\ldots,\overline{S}\}$ we have

$$\frac{h}{cd} \le \frac{\lceil \alpha n \rceil - \hat{N}_k}{\lceil \alpha n \rceil - \hat{N}_k - k}.$$

Multiplying both sides by $cd\left(\lceil \alpha n \rceil - \hat{N}_k - k\right)$,

$$h\left(\lceil \alpha n \rceil - \hat{N}_k - k\right) \le cd\left(\lceil \alpha n \rceil - \hat{N}_k\right).$$

Rearranging the terms,

$$(h - cd)\lceil \alpha n \rceil \le (h - cd)\hat{N}_k + hk.$$

This can be rewritten as,

$$(h - cd)\lceil \alpha n \rceil + h(0) \le (h - cd)\hat{N}_k + hk.$$

The left hand side of the last inequality is $z(\lceil \alpha n \rceil, 0)$. Since this holds for all $k$ under the condition, the optimal solution is to set $S = 0$ and $N = \lceil \alpha n \rceil$.

(c) *Complete centralization*:

If $\frac{h}{cd} \geq \max_{k\in\{0,1,\ldots,\bar{S}-1\}} \left\{ \frac{\hat{N}_k}{\hat{N}_k - (\bar{S} - k)} \right\}$, then for every $k \in \{0,\ldots,\bar{S}-1\}$ we have

$$\frac{h}{cd} \geq \frac{\hat{N}_k}{\hat{N}_k - \bar{S} + k}.$$

Multiplying both sides by $cd(\hat{N}_k - \bar{S} + k)$,

$$h(\hat{N}_k - \bar{S} + k) \geq cd\hat{N}_k.$$

Rearranging the terms,

$$(h - cd)\hat{N}_k + hk \geq h\bar{S}.$$

This can be rewritten as,

$$(h - cd)\hat{N}_k + hk \geq (h - cd)(0) + h\bar{S}.$$

The right hand side of the last inequality is $z(0, \bar{S})$. Since this holds for all $k$, the optimal solution is to set $S = \bar{S}$ and $N = 0$. ■

We can now extend the results from Theorems 2.2 and 2.3 to derive an algorithm for solving the risk pooling problem. The algorithm takes advantage of the fact there are only $\bar{S} + 1$ feasible solutions worth comparing because they form an efficient frontier over the rest of the feasible solutions (from Theorem 2.2).

***Algorithm for the risk pooling problem***

***Step 1***. *If* $\frac{h}{cd} \leq 1$, *then set* $S^* = 0, N^* = n$. *Otherwise, go to step 2.*

***Step 2.*** *Calculate* $\bar{S} = \min_{S\in\{0,1,...\}}\{S : \beta(S, nd) \geq \alpha\}$, and $\hat{N}_k = n - \lfloor \hat{\lambda}_k / d \rfloor$ *for each* $k \in \{0,..., \bar{S}\}$, *where* $\hat{\lambda}_S = \max_{\lambda \leq nd}\{\lambda : \lambda(1-\beta(S,\lambda)) \leq nd(1-\alpha)\}$. *If* $\frac{h}{cd} \leq \min_{k\in\{1,2,...,\bar{S}\}}\left\{\frac{\lceil \alpha n\rceil - \hat{N}_k}{\lceil \alpha n\rceil - \hat{N}_k - k}\right\}$, *then set* $S^* = 0, N^* = \lceil \alpha n\rceil$. *Otherwise, go to step 3.*

***Step 3.*** *If* $\frac{h}{cd} \geq \max_{k\in\{0,1,...,\bar{S}-1\}}\left\{\frac{\hat{N}_k}{\hat{N}_k - (\bar{S}-k)}\right\}$, *then set* $S^* = \bar{S}, N^* = 0$. *Otherwise go to step 4.*

***Step 4:*** *Among all* $k \in \{0,..., \bar{S}\}$, *if* $(k^*, \hat{N}_{k^*})$ *is the pair that yields the smallest objective function value, then set* $S^* = k^*, N^* = \hat{N}_{k^*}$.

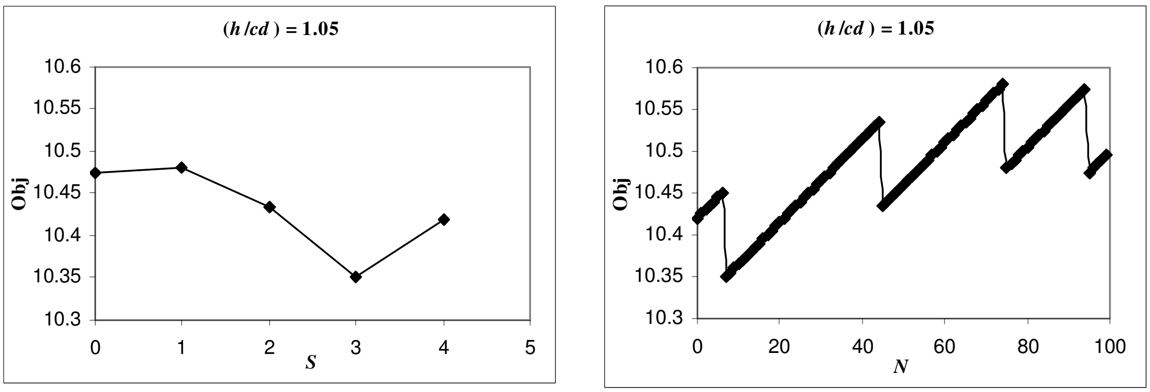
## 5.4 **Numerical example**

Consider a network of $n = 100$ customers each with demand $d = 0.01$. For a service level of $\alpha = 95\%$, $\bar{S} = 4$ units need to be stocked at the shared facility under the complete centralization policy. Suppose the holding cost is $h = 0.105$ per unit time and transportation cost is $c = 10$ per unit demand, then the ratio $\frac{h}{cd} = 1.05$. Table 6 shows the calculations required for the solution algorithm.

Table 6: Calculations for algorithm

| $S$ | $\hat{\lambda}_S$ | $\hat{N}_S$ | $\frac{\lceil \alpha n\rceil - \hat{N}_S}{\lceil \alpha n\rceil - \hat{N}_S - S}$ | $\frac{\hat{N}_S}{\hat{N}_S - (\bar{S}-S)}$ | $z(\hat{N}_S, S)$ |
|---|---|---|---|---|---|
| 0 | 0.05 | 95 | N/A | 1.0439 | 10.475 |
| 1 | 0.25 | 75 | 1.0526 | 1.0416 | 10.480 |
| 2 | 0.55 | 45 | 1.0416 | 1.0465 | 10.435 |
| 3 | 0.93 | 7 | 1.0352 | 1.1666 | 10.350 |
| 4 | 1.00 | 0 | 1.0439 | N/A | 10.420 |

Given that $\frac{h}{cd} = 1.05$ is greater than 1, complete decentralization is not optimal. Since $\frac{h}{cd} = 1.05$ is also greater than 1.0352 (minimum of fourth column in Table 6), we move on to step 3 of the algorithm. The maximum value of the fifth column in Table 6 (1.1666) is greater than $\frac{h}{cd} = 1.05$. Therefore, in step 4 of the algorithm we identify that $z(3,7) = 10.350$ is the smallest value in column six of Table 6 and hence the optimal solution. Figure 8 is a graphical representation of the solution.




(a) $S^* = 3$ (b) $N^* = 7$

Figure 8. Plots of $z(\hat{N}_S, S)$ with respect to $S$ and $N$

The fact that $\overline{S} + 1 = 5$ solutions form an efficient frontier over all other feasible solutions can also be seen in Figure 8(b). We can also use this example to illustrate Theorems 2.2 and 2.3. Figure 9 shows the non-decreasing nature of the service level for given *S* with respect to *N*. In Figure 10, we can see that the objective function curve changes based on the transportation cost and inventory cost parameters.

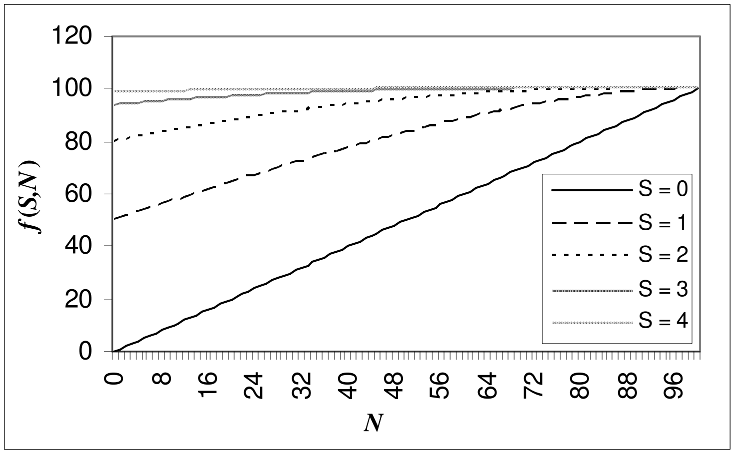
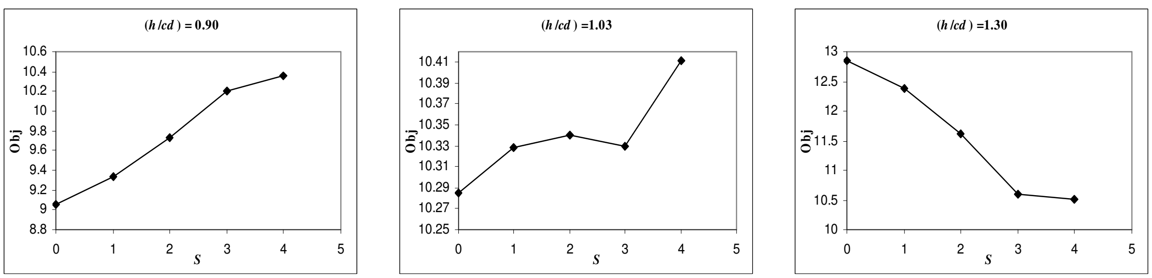



Figure 9.  Illustration of Theorem 2.2




(a) $h = 0.09$ (b) $h = 0.103$ (c) $h = 0.13$

Figure 10.  Illustration of Theorem 2.3

Figure 10(a), Figure 10(b), and Figure 10(c) correspond to (a), (b), and (c) in Theorem 2.3.  Note that as the *h/cd* ratio increases, the optimal solution turns from complete decentralization (Figure 10(a)) to partial decentralization (Figure 10(b) and Figure 8(a)) to complete centralization (Figure 10(c)).

We now test the likelihood that a problem would yield a partially decentralized optimal solution.  We know that this occurs only when the *h/cd* ratio falls in the interval

$$\left( \min_{k\in\{1,2,\ldots,\bar{S}\}} \left\{ \frac{\lceil \alpha n \rceil - \hat{N}_k}{\lceil \alpha n \rceil - \hat{N}_k - k} \right\}, \max_{k\in\{0,1,\ldots,\bar{S}-1\}} \left\{ \frac{\hat{N}_k}{\hat{N}_k - \left(\bar{S} - k\right)} \right\} \right).$$

Define $LB = \min_{k \in \{1,2,\ldots,\bar{S}\}} \left\{ \frac{\lceil \alpha n \rceil - \hat{N}_k}{\lceil \alpha n \rceil - \hat{N}_k - k} \right\}$ and $UB = \max_{k \in \{0,1,\ldots,\bar{S}-1\}} \left\{ \frac{\hat{N}_k}{\hat{N}_k - \left(\bar{S} - k\right)} \right\}$, then the size of the $UB - LB$ gap would give us an idea of the likelihood of partially decentralized optimal solutions.

Consider the experimental design presented in Table 7, with 10 different values of *n*, *α*, and *d*, each represented as a factor in the design. For each of the 1000 combinations, we calculate the $LB$ and $UB$ values (Appendix F). The average gap is 0.033 and the maximum gap is 0.994. Therefore, we can conclude that in most cases, the optimal solution will either be complete centralization or decentralization (with $N \geq \alpha n$ dedicated facilities).

Table 7. Input system parameters for risk pooling DOE

| $n$ | $\alpha$ | $d$ |
|---|---|---|
| 100 | 0.75 | 0.001 |
| 200 | 0.8 | 0.002 |
| 300 | 0.85 | 0.003 |
| 400 | 0.9 | 0.004 |
| 500 | 0.94 | 0.005 |
| 600 | 0.95 | 0.006 |
| 700 | 0.96 | 0.007 |
| 800 | 0.97 | 0.008 |
| 900 | 0.98 | 0.009 |
| 1000 | 0.99 | 0.01 |

Furthermore, each combination in Table 7 yielded an optimal solution with $S^* = 0$, $S^* = \bar{S} - 1$, or $S^* = \bar{S}$, regardless of the cost parameters $h$ and $c$. In other words, suppose $S^* = k$ where $k \in \{1, 2, \ldots, \bar{S} - 2\}$. This could potentially occur only when $k$ satisfies $z\left(\hat{N}_k, k\right) < z(\alpha n, 0)$, $z\left(\hat{N}_k, k\right) < z\left(0, \bar{S}\right)$, and $z\left(\hat{N}_k, k\right) < z\left(\hat{N}_{\bar{S}-1}, \bar{S} - 1\right)$. This can be rewritten as $\frac{\alpha n - \hat{N}_k}{\alpha n - \hat{N}_k - k} < \frac{h}{cd} < \min\left\{ \frac{\hat{N}_k - \hat{N}_{\bar{S}-1}}{\hat{N}_k - \hat{N}_{\bar{S}-1} - \left(\bar{S} - k - 1\right)}, \frac{\hat{N}_k}{\hat{N}_k - \left(\bar{S} - k\right)} \right\}$. This interval does not exist for any of the combinations in Table 7, thus resulting in either $S^* = 0$, $S^* = \overline{S} - 1$, or $S^* = \overline{S}$.

So far in this section, we assume that all the customers are within the time window, and they all have the same demand. This leads us to the result in Theorem 2.2. If we drop these assumptions, then Theorem 2.2 does not necessarily hold.

## 6 Conclusions

In this chapter we allow so-called "dedicated facilities" to be installed at high priority customer locations in an effort to generalize the problem. This enabled us to identify certain special cases of NDIP problem that could be solved as a simple binary knapsack problem, or sometimes even by inspection. Some of this information could be used for pre-processing by variable fixing.

Computational results show us that dedicated facilities become preferable in service parts networks with low holding cost, high demand, and low density of customers. We have also defined specific conditions under which a specific dedicated facility will be opened in any optimal solution. In such cases, the problem with dedicated facilities would solve more quickly than the problem with only shared facilities.

In terms of risk pooling, we obtain boundary conditions on cost parameters beyond which the solution is either complete centralization or complete decentralization. Computational results show that in most cases the gap between the boundary conditions is very small. Moreover, we notice that for such low demand items, the optimal solution turns out to be $S^* = 0$, $S^* = \overline{S} - 1$, or $S^* = \overline{S}$ regardless of the cost parameters.

In the next chapter, we research the idea of inventory sharing so that we can incorporate it into the optimization model.

# Chapter 3: Inventory Sharing

An important characteristic of SPL is that parts have high cost but low demand. For that reason, inventory optimization is a thriving research topic in SPL. In this chapter we incorporate the concept of inventory sharing between facilities within the inventory optimization framework with time based service level constraints. This is achieved by first estimating fill rates analytically, followed by a new network design formulation with the inventory sharing fill rates. As an extension, we also identify cases where inventory sharing could be worse than not sharing inventory.

## 1 Literature review

A recent paper by Burton et al. (2005) showed the superiority of inventory sharing over any other non-sharing policy using a cost parametric analysis. They also showed that ad hoc emergency transshipments are more effective than systematic transshipments based on stock equalization. Moreover, Pyke (1990) also concluded that lateral transshipments have the most impact in the limit when transshipment times go to zero. However, Grahovac et al. (2001) suggested that although inventory sharing may be beneficial from a cost point of view, it may not be favorable for everyone in the supply chain. For example, inventory sharing may reduce holding and shipping costs, but the individual facilities may not be very supportive of fulfilling the demand of other customers which may not count towards their service.

Zhao et al. (2005) further explored this idea from a game theoretic point of view. They allowed each facility to have its own rationing level, which defines the portion of inventory that each facility is willing to share. A Nash equilibrium is guaranteed to exist if each facility attempts to maximize its own service. Rudi et al. (2001) formulated a model that solves for the optimum transshipment prices that induce facilities to make inventory decisions consistent with joint cost minimization.

Modeling inventory of service parts was first explored by Sherbrooke (1968) when he developed the Multi-Echelon Technique for Recoverable Item Control (METRIC) model which could be used to find optimum stock levels to minimize expected backorders subject to the budget. In 1980, Muckstadt et al. extended METRIC to include direct deliveries from the central warehouse by taking advantage of the system structure. Graves (1985) further improved METRIC with his VARI-METRIC model. However, none of these models allowed inventory sharing.

Lee (1987) was the first paper that modeled inventory sharing through lateral transshipments. After dividing facilities among a few pooling groups, he assumed that all the facilities are identical in each pooling group. He also developed an algorithm to solve for optimal stock levels while minimizing holding costs subject to service level constraints. Dropping the assumption of identical facilities in each pooling group, Axsäter (1990) developed a methodology for better results than Lee (1987) assuming exponentially distributed replenishment times. Moinzadeh et al. (1991) also modeled a policy for inventory management with lateral transshipments assuming deterministic lead times.

While Lee (1987) and Axsäter (1990) assumed that facilities with no on-hand inventory cannot act as sources for lateral transshipments, Sherbrooke (1992) allowed these facilities to have backordered lateral transshipments. Whenever replenishment from the central warehouse comes in, these facilities laterally transship the orders to the respective facilities that placed the order. Due to the complexity of this model, Sherbrooke (1992) used simulation as a modeling technique, whereas Wong et al. (2005a) developed an analytic model for the same problem.

Dada (1992) further extended the inventory sharing model to allow items in transit to be used for filling orders as well. This was the first model of its kind. Finally Alfredsson and Verrijdt (1999) combined the works of Dada (1992) and Axsäter (1990) to develop an analytic model that calculates the fraction of demand of a customer satisfied by different sources such as the regular order fills from the assigned facility, lateral transshipments from other facilities, direct shipments from the central warehouse etc. Alfredsson and Verrijdt (1999) concluded that the distribution of shipment times has a negligible effect on the overall model.

A number of papers have been written on variations of these inventory models. Herer et al. (1999) included replenishment costs into the model, and Wong et al. (2005b) included downtime cost but ignore service level constraints in the model. Axsäter (2003) formulated a model to minimize the expected cost assuming that no more lateral transshipments will take place in the future, whereas Aggrawal et al. (1994) completely ignored lateral transshipments and their strategy is production to order. In other words, it is a pull strategy through the supply chain that results in no stock at any of the facilities. While all the above mentioned models are continuous review models, Tagaras (1989) and Archibald et al. (1995) developed periodic review models for the same problem.

In this chapter, we extend the works of Lee (1987) and Alfredsson and Verrijdt (1999). Let us define a "pool" to be a set of stocking facilities that are allowed to share inventory. Then demand occurring at a facility is satisfied in the following order:

- If the facility has stock on-hand, then this on-hand stock is used to satisfy the demand.
- If the facility is out of stock and another facility in the pool has stock on-hand, then demand is satisfied by the other facility.
- If all the facilities in the pool are out of stock, then demand is satisfied by a direct shipment from the central warehouse which has infinite supply. However, this will be counted as a lost sale for the assigned facility.

Note that all the facilities in this chapter are shared facilities, and all of them are replenished from the central warehouse according to the base stock policy.

Lee (1987) analyzed a multiple pool system assuming that all the facilities in a given pool are identical whereas Axsäter (1990) allowed non-identical facilities in the same pool. Later on, Alfredsson and Verrijdt (1999) extended Axsäter's (1990) model by allowing the central warehouse to run out of stock, in which case it will be replenished by the plant, which has infinite supply. They also allowed each facility to share inventory with every other facility (i.e. all facilities belong to the same big pool). A comparison of the three papers is shown in Table 8.

Table 8. Comparison of the relevant papers in inventory sharing

| **Alfredsson and Verrijdt (1999)** | **Lee (1987)** | **This chapter** |
|---|---|---|
| Supply chain network has four echelons (includes plant) | Supply chain network has three echelons | Supply chain network has three echelons |
| New parts are produced in the plant | No new parts are produced (parts are recycled) | New parts are distributed from the central warehouse |
| Base stock replenishment policy | Base stock replenishment policy | Base stock replenishment policy |
| Unsatisfied demand is lost | Unsatisfied demand is backordered | Unsatisfied demand is lost |
| Only one pool exists, but facilities within it need not be identical | Many pools exist, but all facilities within a pool are identical | Many pools exist, and all facilities within a pool need not be identical, but only two facilities are allowed in each pool |

When we consider inventory sharing between facilities, estimating fill rates becomes a challenge. Alfredsson and Verrijdt (1999) estimated these probabilities iteratively using Markov chains. In this chapter however, we use the low demand nature of spare parts to simplify the Markov chain based iterative formula into a set of simultaneous equations. Furthermore, we incorporate the inventory sharing formulae within the inventory optimization problem with time based service level constraints.

***Inventory Optimization Problem***

Consider a network of inventory stocking facilities across the nation. Each existing customer is assigned to a specific stocking facility for spare parts, but the facility should be stocked well enough to satisfy a target service level. The two decision variables here are (1) allocation of customer demand to facilities and (2) stock levels at each facility.

The main trade-off is between the inventory holding cost and the transportation cost. Decreasing the stock level at a facility would reduce the inventory cost, but the fill rate is also reduced. Therefore a customer in close proximity to the facility may have to be reassigned to another facility (at a larger distance) in order to maintain the target service level, which in turn increases the transportation cost. Note that the holding cost is accompanied by the fixed cost of opening and operating the facility.

This problem of minimizing the total inventory cost, fixed cost, and transportation cost subject to a service level constraint is what we call the "inventory optimization problem". In this problem, the service level constraint ensures that the target service level percentage of total demand is satisfied within a predefined time window.

As mentioned earlier, inventory holding cost per unit is high for spare parts. Therefore, we would like to consider sharing of inventory between facilities such that inventory cost is reduced without much reduction in fill rates.

## 2 Single pool inventory problem with inventory sharing

In this section we formulate the inventory optimization problem for a single pool of two facilities with inventory sharing between the facilities. In this regard, first we modify the iterative methodology of Alfredsson and Verrijdt (1999) in estimating the local and lateral fill rates for a single pool with two facilities. We then formulate equations to estimate the fill rates (as opposed to using the iterative methodology of Alfredsson and Verrijdt (1999)).

### 2.1 **Estimating fill rates**

Consider a system of two facilities belonging to the same pool (Figure 11). Suppose $I = \{1,2\}$ is the set of facilities. At each facility $i \in I$, let $S_i$ denote the stock level and let us redefine $\lambda_i$ to be the demand "rate" (as opposed to mean demand during lead time in Chapter 2). The fill rates are as follows:

$\beta_i$-fraction of demand satisfied by on-hand stock at the facility *i*,

$\gamma_i$-fraction of demand of facility *i* satisfied by lateral transshipment from another facility in the pool, and

$\theta$-fraction of demand satisfied by a direct shipment from the central warehouse (CW).

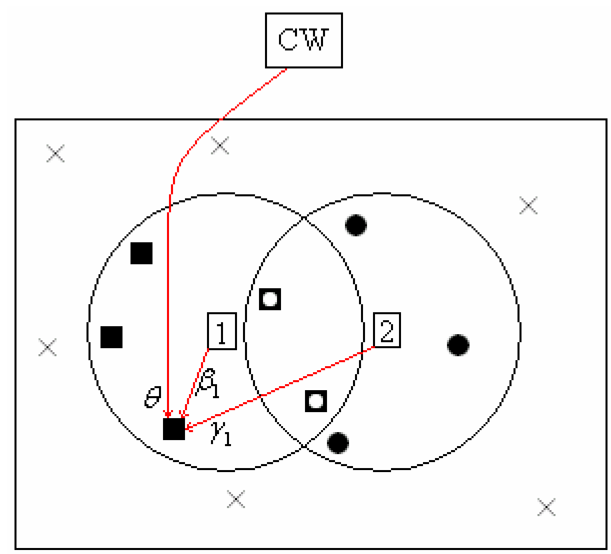



Figure 11. Two facility pool

Note that the customers that are only within the time window of facility 1 are symbolized by "■" in Figure 11, those that are only within the time window of facility 2 are shown as "●", and the "◘" symbols are those customers within the time window of both facilities.

On the other hand, let "×" be those customers that do not fall within the time window of either facility.

Given that a shipment from the central warehouse is required only when the entire pool runs out of inventory, we estimate $\theta$ using a Markov chain with demand and stock aggregated over the entire pool. Next, the local fill-rate ($\beta_i$) at each facility is estimated using a Markov chain (for each facility) where lateral demand is added to the local demand.

***Iterative method of estimating fill rates***

Step 1: Estimating $\theta$;

Combine all the facilities within the pool into an aggregate facility with stock level $\overline{S} = S_1 + S_2$, replenishment rate $\mu$ and demand rate $\overline{\lambda} = \lambda_1 + \lambda_2$. Suppose $k$ denotes the on-hand inventory level at the aggregate facility, then let each $k = 0,1,..,\overline{S}$ be a single state in a continuous time Markov chain as seen in Figure 12.

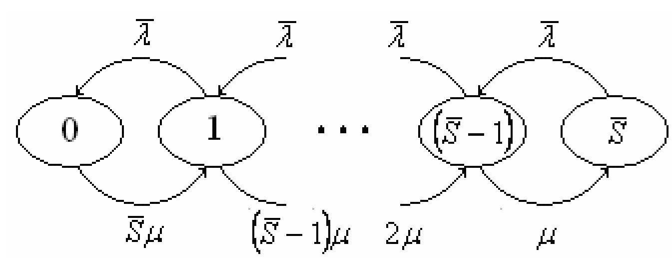



Figure 12. State transition diagram for the pool

We can now obtain the steady state probability that the pool has an aggregate inventory of $k$ units $(\pi^k)$ by solving the following equations:

$$\pi^k = \frac{\overline{S}!}{(\overline{S}-k)!}\left(\frac{\mu}{\overline{\lambda}}\right)^k \pi^0 \quad \forall k = 0,1,..,\overline{S}, \tag{3.1}$$

$$\sum_{k=0}^{\bar{S}} \pi^k = \sum_{k=0}^{\bar{S}} \frac{\bar{S}!}{(\bar{S}-k)!} \left(\frac{\mu}{\lambda}\right)^k \pi^0 = 1, \tag{3.2}$$

where equation (3.1) is the rate equation and equation (3.2) is the normalizing equation.

The probability that demand is satisfied by a direct shipment from the central warehouse $(\theta)$ is the probability that the entire pool has zero units on-hand in the long run, i.e.,

$$\theta = \pi^0. \tag{3.3}$$

Note that all the facilities in the same pool will have the same value for $\theta$.

Step 2: Estimating $\beta$ and $\gamma$;

Suppose $e_i$ is the rate of lateral transshipments from the other facility in the pool. Alfredsson and Verrijdt (1999) approximated $e_1 = \frac{\gamma_2 \lambda_2}{\beta_1}$ and $e_2 = \frac{\gamma_1 \lambda_1}{\beta_2}$, which is the fraction of demand rate from the other facility conditioned on the probability that the facility has stock on-hand. For any value of $e_i$, the long run total demand rate at facility $i$ is $\lambda_i + e_i$. In the long run, the demand process at a facility with lateral transshipments can be approximated as a Poisson process (verified using simulation).

We can now setup another continuous time Markov chain where each state $l$ corresponds to the on-hand inventory level at facility $i$ (Figure 13).

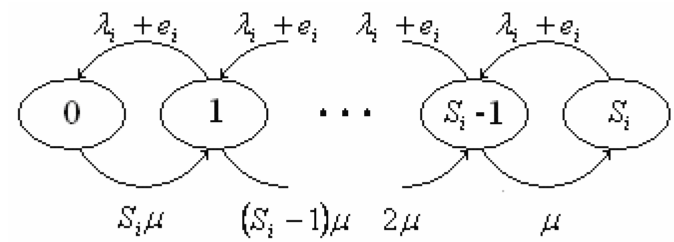


Figure 13. State transition diagram for each facility $i$

Let $\phi_i^l$ be the steady state probability that facility $i$ has $l$ units of inventory on-hand. The steady state probabilities can be obtained by solving the following equations:

$$\phi_i^l = \frac{S_i!}{(S_i - l)!}\left(\frac{\mu}{\lambda_i + e_i}\right)^l \phi_i^0 \quad \forall l = 0,1,..,S_i, \tag{3.4}$$

$$\sum_{l=0}^{S_i} \phi_i^l = \sum_{l=0}^{S_i} \frac{S_i!}{(S_i - l)!}\left(\frac{\mu}{\lambda_i + e_i}\right)^l \phi_i^0 = 1, \tag{3.5}$$

where equation (3.4) is the rate equation and equation (3.5) is the normalizing equation.

The probability that demand at facility $i$ is satisfied by on-hand inventory is the probability that the on-hand inventory is greater than 0 in the long run, i.e.,

$$\beta_i = 1 - \phi_i^0. \tag{3.6}$$

We also know that

$$\beta_i + \gamma_i + \theta = 1. \tag{3.7}$$

The above formulae show us that $e_i$, $\beta_i$, and $\gamma_i$ are dependent on each other. Therefore, using $e_i = 0$ as a starting point, we can now iteratively update the values of $\beta_i$ and $\gamma_i$ until they converge.

For example, consider the following two-facility pool (Table 9).

Table 9. Input parameters for iterative estimation of fill rates

| | $i = 1$ | $i = 2$ |
|---|---|---|
| $\lambda_i$ | 0.15 | 0.2 |
| $S_i$ | 1 | 1 |

Using the input values shown in Table 9 and a replenishment rate of $\mu = 1$, we first calculate the probability that the entire pool stocks out, i.e. $\theta$ = 0.0434 (step 1). Based on this, Table 10 shows multiple iterations of step 2.

Table 10. Results by iteration of fill rate estimation

| | $e_i$ | | $\gamma_i$ | | $\beta_i$ | | |
|---|---|---|---|---|---|---|---|
| Iteration | $i = 1$ | $i = 2$ | $i = 1$ | $i = 2$ | $i = 1$ | $i = 2$ | Gap |
| 0 | 0 | 0 | 0.087 | 0.1233 | 0.8696 | 0.8333 | 0.215075894 |
| 1 | 0.0284 | 0.0157 | 0.108 | 0.134 | 0.8486 | 0.8226 | 0.0263908 |
| 2 | 0.0316 | 0.0197 | 0.1103 | 0.1367 | 0.8463 | 0.8199 | 0.005469977 |
| 3 | 0.0323 | 0.0202 | 0.1108 | 0.137 | 0.8458 | 0.8196 | 0.000775356 |
| 4 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 0.000145339 |
| 5 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | **2.217E-05** |
| 6 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 3.93213E-06 |
| 7 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 6.24038E-07 |
| 8 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 1.07454E-07 |
| 9 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 1.7424E-08 |
| 10 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 2.95275E-09 |
| 11 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 4.8441E-10 |
| 12 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 8.13862E-11 |
| 13 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 1.3436E-11 |
| 14 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 2.24785E-12 |
| 15 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 3.72472E-13 |
| 16 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 6.20787E-14 |
| 17 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 1.1014E-14 |
| 18 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 2.00254E-15 |
| 19 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 1.00127E-15 |
| 20 | 0.0324 | 0.0203 | 0.1109 | 0.1371 | 0.8457 | 0.8195 | 0 |

We see that 5 iterations are enough to estimate the values of $\beta_i$ and $\gamma_i$ within 0.002 % of the actual values. Therefore, we observe that the iterative procedure of estimating fill rates converges quickly. However, from an optimization point of view we would like to have analytic equations to estimate $\beta_i$ and $\gamma_i$ values.

***Analytic method of estimating fill rates***

Using equations (3.1), (3.2), and (3.3), we know that

$$\theta = \pi^0 = \frac{1}{\sum_{k=0}^{\bar{S}} \frac{\bar{S}!}{(\bar{S}-k)!}\left(\frac{\mu}{\bar{\lambda}}\right)^k}. \tag{3.8}$$

Combining equations (3.4), (3.5), and (3.6),

$$\begin{aligned}\beta_i &= 1-\phi_i^0 \\ &= 1-\frac{1}{\sum_{l=0}^{S_i} \frac{S_i!}{(S_i-l)!}\left(\frac{\mu}{\lambda_i+e_i}\right)^l}.\end{aligned}$$

For a single pool with two facilities, $e_1 = \frac{\gamma_2\lambda_2}{\beta_1}$ and $e_2 = \frac{\gamma_1\lambda_1}{\beta_2}$ (Alfredsson and Verrijdt (1999)). We now replace the value of $e_1$ in the formula of $\beta_1$, i.e.,

$$\begin{aligned}\beta_1 &= 1-\frac{1}{\sum_{l=0}^{S_1} \frac{S_1!}{(S_1-l)!}\left(\frac{\mu}{\lambda_1+e_1}\right)^l} \\ &= 1-\frac{1}{\sum_{l=0}^{S_1} \frac{S_1!}{(S_1-l)!}\left(\frac{\mu}{\lambda_1+\frac{\gamma_2\lambda_2}{\beta_1}}\right)^l},\end{aligned}$$

and a similar equation can be written for $\beta_2$. But we also know that $\gamma_i = 1-\beta_i-\theta$ from equation (3.7). Therefore, the values of $\beta_1$ and $\beta_2$ can be obtained by simultaneously solving the following equations:

$$\beta_1 + \frac{1}{\sum_{l=0}^{S_1} \frac{S_1!}{(S_1 - l)!} \left( \frac{\mu}{\lambda_1 + \frac{(1-\theta-\beta_2)\lambda_2}{\beta_1}} \right)^l} = 1, \tag{3.9}$$

$$\beta_2 + \frac{1}{\sum_{l=0}^{S_2} \frac{S_2!}{(S_2 - l)!} \left( \frac{\mu}{\lambda_2 + \frac{(1-\theta-\beta_1)\lambda_1}{\beta_2}} \right)^l} = 1. \tag{3.10}$$

As a verification step, we implemented equations (3.8), (3.9), and (3.10) on the input data from Table 9 in Excel and ensured that we obtained the same values for the fill rates as we did in the iterative procedure. Moreover, we also checked these values with an Arena based simulation model. Note that all the following work in this dissertation is based on the validity of the fill rate approximation. The long run fill rates in the simulation model were the same as those from equations (3.8), (3.9), and (3.10) up to the fifth decimal place.

***Special case in SPL***

Due to the low demand nature of spare parts in SPL, let us assume that $S_i = 1$ is sufficient to satisfy all the demand assigned to facility $i$. That is, it is sufficient to consider the stock level at a facility to be 0 or 1. Suppose the lead time is 1 week, then this corresponds to a maximum demand rate of 0.01 per facility per week for 100% service. We continue to hold this assumption for the remainder of this chapter. Based on this assumption, equations (3.9) and (3.10) can be further simplified through a series of algebraic manipulations as shown below. If $S_1 = 1$, then

$$\beta_1 = 1 - \frac{1}{\sum_{l=0}^{1} \frac{1!}{(1-l)!} \left( \frac{\mu}{\lambda_1 + \frac{\gamma_2 \lambda_2}{\beta_1}} \right)^l}.$$

Expanding the sum and simplifying the fraction we obtain,

$$\beta_1 = \frac{\mu - \gamma_2 \lambda_2}{\mu + \lambda_1} = \frac{\mu - (1 - \beta_2 - \theta)\lambda_2}{\mu + \lambda_1},$$

and similarly if $S_2 = 1$, then,

$$\beta_2 = \frac{\mu - \gamma_1 \lambda_1}{\mu + \lambda_2} = \frac{\mu - (1 - \beta_1 - \theta)\lambda_1}{\mu + \lambda_2}.$$

Therefore, if $S_1 = 1$ and $S_2 = 1$, the above equations can be solved simultaneously to obtain the following equations for the fill rates. From equation (3.8),

$$\theta = \frac{\overline{\lambda}^2}{(\overline{\lambda} + \mu)^2 + \mu^2}. \tag{3.8′}$$

Inserting $\theta$ into the simplified versions of equations (3.9) and (3.10),

$$\beta_1 = \frac{\mu\left(\overline{\lambda}^2 + 2\mu^2 + 2\mu(\lambda_2 + \overline{\lambda})\right)}{(\overline{\lambda} + \mu)\left((\overline{\lambda} + \mu)^2 + \mu^2\right)}, \text{ and} \tag{3.9′}$$

$$\beta_2 = \frac{\mu\left(\overline{\lambda}^2 + 2\mu^2 + 2\mu(\lambda_1 + \overline{\lambda})\right)}{(\overline{\lambda} + \mu)\left((\overline{\lambda} + \mu)^2 + \mu^2\right)}. \tag{3.10′}$$

Replacing $\theta$ and $\beta$ in equation (3.7),

$$\gamma_1 = \frac{\mu\left(\overline{\lambda}^2 + 2\mu\lambda_1\right)}{(\overline{\lambda} + \mu)\left((\overline{\lambda} + \mu)^2 + \mu^2\right)}, \text{ and} \tag{3.11}$$

$$\gamma_2 = \frac{\mu\left(\overline{\lambda}^2 + 2\mu\lambda_2\right)}{(\overline{\lambda} + \mu)\left((\overline{\lambda} + \mu)^2 + \mu^2\right)}. \tag{3.12}$$

As a result, under the low demand assumption of SPL, we are able to accurately estimate the fill rates for given demand rates and stock levels in a two-facility pool without iterations.

The fill rate estimation equations assume that we know the demand allocation and the stock levels at each facility. Suppose we do not have this information, and we would like to find the optimal demand allocation and stock levels such that a time based service constraint is satisfied. In order to do this, let us first define some new notation.

### 2.2 **Notation/Assumptions**

In this chapter, we allow customers to be assigned to facilities with no stock (which was not allowed in Chapter 2). This is because inventory is now shared between facilities. Furthermore, in this chapter we continue to assume that customers cannot be directly assigned to the central warehouse (as in Chapter 2), but there exists a transportation cost component for demand satisfied from the central warehouse when all the facilities in the pool are out of stock.

Suppose $d_1$, $d_2$, $d_0$, and $d_{-1}$ are demand parameters such that $d_1$ is the total demand rate from customers only within the time window of facility 1, $d_2$ is the total demand rate from customers only within the time window of facility 2, $d_0$ is the total demand rate from customers that are within the time window of both facility 1 and facility 2, and $d_{-1}$ is the total demand rate from customers that are not within the time window of any facility. Referring back to Figure 11, $d_1$ corresponds to the set of "■" customers, $d_2$ corresponds to the set of "●" customers, $d_0$ corresponds to the set of "◘" customers, and $d_{-1}$ corresponds to the set of "×" customers.

Let $X_{01}$, $X_{11}$, $X_{21}$, $X_{-11}$, $X_{02}$, $X_{22}$, $X_{12}$, $X_{-12}$ be demand allocation variables where

$X_{01}$ – demand within the time window of both facilities assigned to facility 1

$X_{11}$ – demand within the time window of facility 1 assigned to facility 1

$X_{21}$ – demand within the time window of facility 2 assigned to facility 1

$X_{-11}$ – demand outside the time window of both facilities assigned to facility 1

$X_{02}$ – demand within the time window of both facilities assigned to facility 2

$X_{22}$ – demand within the time window of facility 2 assigned to facility 2

$X_{12}$ – demand within the time window of facility 1 assigned to facility 2

$X_{-12}$ – demand outside the time window of both facilities assigned to facility 2

In other words, $d_1 = X_{11} + X_{12}$, $d_2 = X_{21} + X_{22}$, $d_0 = X_{01} + X_{02}$, and $d_{-1} = X_{-11} + X_{-12}$. An illustration of the notation can be seen in Figure 14.

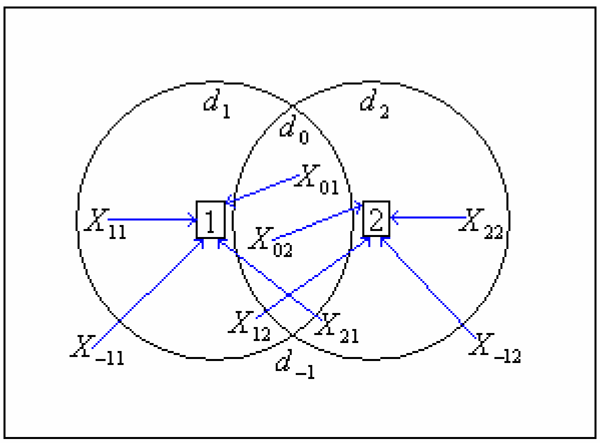



Figure 14. Demand allocation variables in the two facility pool

With a fixed cost of $f$ to open and operate a facility per unit time (say 1 week), and a unit holding cost of $h$ per unit time, suppose we have the following additional cost parameters: $c^{in}$ is the unit transportation cost of demand satisfied within the time window of a facility, $c^{out}$ is the unit transportation cost of demand satisfied outside the time window of the facility, and $c^{e}$ is the transportation cost of demand satisfied as an emergency shipment from the central warehouse. Note that we inherently assume that $c^{in} \leq c^{out}$.

### 2.3 **Formulation of a single two-facility pool problem**

A breakdown of the total cost is given as follows:

Fixed cost and Inventory cost = $(f+h)(S_1+S_2)$

$$\text{Local transportation cost} = c^{in}\beta_1(X_{01}+X_{11})+c^{out}\beta_1(X_{21}+X_{-11}) + c^{in}\beta_2(X_{02}+X_{22})+c^{out}\beta_2(X_{12}+X_{-12})$$

$$\text{Lateral transportation cost} = c^{in}\gamma_1(X_{01}+X_{21})+c^{out}\gamma_1(X_{11}+X_{-11}) + c^{in}\gamma_2(X_{02}+X_{12})+c^{out}\gamma_2(X_{22}+X_{-12})$$

$$\text{Emergency transportation cost} = c^{e}\theta(X_{01}+X_{11}+X_{21}+X_{-11}+X_{02}+X_{22}+X_{12}+X_{-12}) = c^{e}\theta\overline{\lambda}$$

Note that the total cost function is different from that of Chapter 2. Now that we allow inventory sharing, we need to know where the part actually comes from (as opposed to just knowing which facility the customer is assigned to).

The proportion of satisfied demand that falls within the time window is

$$\beta_1(X_{01}+X_{11})+\gamma_1(X_{01}+X_{21})+\beta_2(X_{02}+X_{22})+\gamma_2(X_{02}+X_{12}).$$

Suppose we require $\alpha$ of the total pool demand to be satisfied within the time window. We can now formulate an optimization problem that minimizes the total cost subject to a time based service level constraint.

**P$_3$:** Minimize

$$z(S_1,S_2) = (f+h)(S_1+S_2)$$
$$+c^{in}\beta_1(X_{01}+X_{11})+c^{out}\beta_1(X_{21}+X_{-11})+c^{in}\beta_2(X_{02}+X_{22})+c^{out}\beta_2(X_{12}+X_{-12})$$
$$+c^{in}\gamma_1(X_{01}+X_{21})+c^{out}\gamma_1(X_{11}+X_{-11})+c^{in}\gamma_2(X_{02}+X_{12})+c^{out}\gamma_2(X_{22}+X_{-12})$$

$$+c^e\theta\overline{\lambda} \tag{3.13a}$$

subject to

$$u(S_1,S_2)=\beta_1(X_{01}+X_{11})+\gamma_1(X_{01}+X_{21})$$

$$+\beta_2(X_{02}+X_{22})+\gamma_2(X_{02}+X_{12})\geq\alpha\overline{\lambda} \tag{3.13b}$$

$$d_1=X_{11}+X_{12} \tag{3.13c}$$

$$d_2=X_{21}+X_{22} \tag{3.13d}$$

$$d_0=X_{01}+X_{02} \tag{3.13e}$$

$$d_{-1}=X_{-11}+X_{-12} \tag{3.13f}$$

$$X_{01},X_{11},X_{21},X_{-11},X_{02},X_{22},X_{12},X_{-12}\geq 0 \tag{3.13g}$$

$$S_1,S_2\in\{0,1,2,...\}. \tag{3.13h}$$

where the fill rates $\theta,\beta_1,\beta_2,\gamma_1$, and $\gamma_2$ are estimated based on equations (3.7),(3.8), (3.9), and (3.10).

### 2.4 **Theoretical results**

Problem $\mathbf{P_3}$ is a non-linear integer optimization problem, however the low demand nature of SPL enables us to simplify the problem. In fact, if we limit $S_1,S_2\in\{0,1\}$ then the entire problem has a trivial solution (can be solved by inspection). The following theorems build up a case to prove this claim.

**Theorem 3.1:** *If* $S_1,S_2\in\{0,1\}$ *and* $d_1\geq d_2$, *then the solution to problem* $\mathbf{P_3}$ *is either* $(S_1,S_2)=(1,0)$ *or* $(S_1,S_2)=(1,1)$.

**Proof:** The possible solutions to $(S_1,S_2)$ are $(0,0)$, $(0,1)$, $(1,0)$, and $(1,1)$. Assuming that $\alpha>0$, we can eliminate $(0,0)$ as a solution.

In order to compare $(S_1,S_2)=(0,1)$ and $(S_1,S_2)=(1,0)$, consider the case where $(S_1,S_2)=(1,0)$. Since $S_2=0$, $\beta_2=\gamma_1=0$. Also, $\theta=\dfrac{\overline{\lambda}}{\overline{\lambda}+\mu}$ since $\overline{S}=S_1+S_2=1$.

Therefore, $\beta_1 = \gamma_2 = \frac{\mu}{\overline{\lambda} + \mu}$ by solving equations (3.9) and (3.10). After calculating the fill rates in a similar way for $(S_1, S_2) = (0,1)$, we can incorporate them in $z(S_1, S_2)$ and $u(S_1, S_2)$ as follows.

$$u(1,0) = \frac{\mu}{\overline{\lambda} + \mu}(d_0 + d_1)$$

$$u(0,1) = \frac{\mu}{\overline{\lambda} + \mu}(d_0 + d_2)$$

$$z(1,0) = (f + h) + \frac{\overline{\lambda}^2}{\overline{\lambda} + \mu}c^e + \frac{\mu}{\overline{\lambda} + \mu}(d_0 + d_1)c^{in} + \frac{\mu}{\overline{\lambda} + \mu}(d_2 + d_{-1})c^{out}$$

$$z(0,1) = (f + h) + \frac{\overline{\lambda}^2}{\overline{\lambda} + \mu}c^e + \frac{\mu}{\overline{\lambda} + \mu}(d_0 + d_2)c^{in} + \frac{\mu}{\overline{\lambda} + \mu}(d_1 + d_{-1})c^{out}$$

We observe that $u(1,0) \geq u(0,1)$ and $z(1,0) \leq z(0,1)$ if $d_1 \geq d_2$. However, without loss of generality we can "rename" the larger demand region as $d_1$. As a result, $(S_1, S_2) = (1,0)$ dominates $(S_1, S_2) = (0,1)$ as a solution. Strictly speaking, $(S_1, S_2) = (1,0)$ and $(S_1, S_2) = (1,1)$ are undominated solutions to problem **P₃**. ■

**Corollary 3.1.1:** *For stock level* $(S_1, S_2) = (1,0)$ *and* $d_1 \geq d_2$, *any feasible demand allocation solution is optimal.*

**Proof:** From Theorem 3.1, if $(S_1, S_2) = (1,0)$, then

$$u(1,0) = \frac{\mu}{\overline{\lambda} + \mu}(d_0 + d_1), \text{ and}$$

$$z(1,0) = (f + h) + \frac{\overline{\lambda}^2}{\overline{\lambda} + \mu}c^e + \frac{\mu}{\overline{\lambda} + \mu}(d_0 + d_1)c^{in} + \frac{\mu}{\overline{\lambda} + \mu}(d_2 + d_{-1})c^{out}.$$

The demand allocation variables do not appear in the constraint or in the objective function. Therefore, any feasible set of $X_{01}$, $X_{11}$, $X_{21}$, $X_{-11}$, $X_{02}$, $X_{22}$, $X_{12}$, $X_{-12}$ values is optimal. ■

Therefore, if $(S_1, S_2) = (1,0)$, we could potentially assign all the demand to facility 1. For $(S_1, S_2) = (1,1)$, if we can prove a result similar to Corollary 3.1.1, then we can conclude that problem **P3** is trivial.

**Theorem 3.2:** *For stock levels of* $(S_1, S_2) = (1,1)$ *and* $d_1 \geq d_2$,*, the optimal demand allocation is* $X_{01} = 0$, $X_{02} = d_0$, $X_{11} = d_1$, $X_{12} = 0$, $X_{21} = 0$, $X_{22} = d_2$, $X_{-11} = 0$, *and* $X_{-12} = d_{-1}$.

**Proof:** In the case where $(S_1, S_2) = (1,1)$, the fill rates are given in equations (3.8′), (3.9′), (3.10′), (3.11), and (3.12). Inserting these fill rates into $z(S_1, S_2)$ and $u(S_1, S_2)$, we obtain the following equations.

$$z(1,1) = 2(f+h) + \frac{\bar{\lambda}^3}{(\bar{\lambda}+\mu)^2+\mu^2}c^e + \frac{\mu}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}\begin{Bmatrix} \left(\bar{\lambda}^2 + 2(X_{01}+X_{11}+X_{21}+X_{-11})\mu\right)\left((d_0+d_2)c^{in} + (d_1+d_{-1})c^{out}\right) \\ +\left(\bar{\lambda}^2 + 2(X_{02}+X_{22}+X_{12}+X_{-12})\mu\right)\left((d_0+d_1)c^{in} + (d_2+d_{-1})c^{out}\right) \\ +2\mu(\bar{\lambda}+\mu)\left(d_0c^{in} + d_{-1}c^{out} + (X_{11}+X_{22})c^{in} + (X_{21}+X_{12})c^{out}\right) \end{Bmatrix}$$

$$u(1,1) = \left(1 - \frac{\bar{\lambda}^2}{(\bar{\lambda}+\mu)^2+\mu^2}\right)d_0 + \frac{\mu}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}\begin{Bmatrix} \bar{\lambda}^2(d_1+d_2) + 2\mu(\bar{\lambda}+\mu+d_2)X_{11} \\ +2\mu(\bar{\lambda}+\mu+d_1)X_{22} \\ +2\mu d_2(X_{01}+X_{21}) + 2\mu d_1(X_{02}+X_{12}) \end{Bmatrix}$$

Let us now compare the coefficients of $X_{01}$ and $X_{02}$ in $z(1,1)$ and $u(1,1)$.

$z(1,1)$ coefficient of $X_{01}$: $\dfrac{2\mu^2\left((d_0+d_2)c^{in}+(d_1+d_{-1})c^{out}\right)}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$

$z(1,1)$ coefficient of $X_{02}$: $\dfrac{2\mu^2\left((d_0+d_1)c^{in}+(d_2+d_{-1})c^{out}\right)}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$

$u(1,1)$ coefficient of $X_{01}$: $\dfrac{2\mu^2 d_2}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$

$u(1,1)$ coefficient of $X_{02}$: $\dfrac{2\mu^2 d_1}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$

We observe that when $d_1 \geq d_2$ (without loss of generality), the objective function coefficient of $X_{02}$ is less than that of $X_{01}$ and the constraint coefficient of $X_{02}$ is greater than that of $X_{01}$ (i.e., $X_{02}$ dominates $X_{01}$). As mentioned earlier in Theorem 3.1, we can assume $d_1 \geq d_2$ without loss of generality. In effect, $X_{01}=0$ and $X_{02}=d_0$ if $(S_1,S_2)=(1,1)$.

Similarly we can compare the coefficients of $X_{11}$, $X_{12}$, $X_{21}$, $X_{22}$, $X_{-11}$, and $X_{-12}$ in $z(1,1)$ and $u(1,1)$.

$X_{11}$ in $z(1,1)$: $\dfrac{2\mu^2\left((d_0+d_2)c^{in}+(d_1+d_{-1})c^{out}+(\bar{\lambda}+\mu)c^{in}\right)}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$

$X_{12}$ in $z(1,1)$: $\dfrac{2\mu^2\left((d_0+d_1)c^{in}+(d_2+d_{-1})c^{out}+(\bar{\lambda}+\mu)c^{out}\right)}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$

$X_{21}$ in $z(1,1)$: $\dfrac{2\mu^2\left((d_0+d_2)c^{in}+(d_1+d_{-1})c^{out}+(\bar{\lambda}+\mu)c^{out}\right)}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$

$X_{22}$ in $z(1,1)$: $\dfrac{2\mu^2\left((d_0+d_1)c^{in}+(d_2+d_{-1})c^{out}+(\bar{\lambda}+\mu)c^{out}\right)}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$

$X_{-11}$ in $z(1,1)$: $\dfrac{2\mu^2\left((d_0+d_2)c^{in}+(d_1+d_{-1})c^{out}\right)}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$

$$X_{-12} \text{ in } z(1,1): \frac{2\mu^2\left((d_0+d_1)c^{in}+(d_2+d_{-1})c^{out}\right)}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$$

$$X_{11} \text{ in } u(1,1): \frac{2\mu^2\left(\bar{\lambda}+\mu+d_2\right)}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$$

$$X_{12} \text{ in } u(1,1): \frac{2\mu^2 d_1}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$$

$$X_{21} \text{ in } u(1,1): \frac{2\mu^2 d_2}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$$

$$X_{22} \text{ in } u(1,1): \frac{2\mu^2\left(\bar{\lambda}+\mu+d_1\right)}{(\bar{\lambda}+\mu)\left((\bar{\lambda}+\mu)^2+\mu^2\right)}$$

$$X_{-11} \text{ in } u(1,1): 0$$

$$X_{-12} \text{ in } u(1,1): 0$$

We again observe the dominance of $X_{11}$ over $X_{12}$, $X_{22}$ over $X_{21}$, and $X_{-12}$ over $X_{-11}$ when $d_1 \geq d_2$. Therefore, in the case where $(S_1, S_2) = (1,1)$, $X_{11} = d_1$, $X_{12} = 0$, $X_{22} = d_2$, $X_{21} = 0$, $X_{-12} = d_{-1}$, and $X_{-11} = 0$. The demand allocation can be obtained by inspection when $(S_1, S_2) = (1,1)$. ■

In other words, if we decide to open and stock a single unit at each facility, then the demand that is only within the time window of facility 1 should be assigned to facility 1. All the rest of the demand should be assigned to facility 2. Intuitively, this makes sense because $d_1 \geq d_2$. So, the facility with less demand within its time window is assigned to more customers.

Moreover, for every stock level combination, we can now calculate the objective function and constraint values. We know that

$$z(0,0) = c^e \bar{\lambda}\,, \tag{3.14}$$

and

$$u(0,0) = 0\,. \tag{3.15}$$

From Theorem 3.1,

$$z(1,0) = (f + h) + \frac{\bar{\lambda}^2}{\bar{\lambda} + \mu} c^e + \frac{\mu}{\bar{\lambda} + \mu}\left((d_0 + d_1)c^{in} + (d_2 + d_{-1})c^{out}\right), \tag{3.16}$$

$$u(1,0) = \frac{\mu}{\bar{\lambda} + \mu}(d_0 + d_1), \tag{3.17}$$

and from Theorem 3.2,

$$\begin{aligned} z(1,1) = {} & 2(f + h) + \frac{\bar{\lambda}^3}{(\bar{\lambda} + \mu)^2 + \mu^2} c^e \\ & + \frac{\mu}{(\bar{\lambda} + \mu)\left((\bar{\lambda} + \mu)^2 + \mu^2\right)} \left\{ \begin{array}{l} c^{in} \left( \begin{array}{l} (\bar{\lambda}^2 + 2\mu d_1)(d_0 + d_2) \\ + (\bar{\lambda}^2 + 2\mu(d_0 + d_2 + d_{-1}))(d_0 + d_1) \\ + 2\mu(\bar{\lambda} + \mu)(d_0 + d_1 + d_2) \end{array} \right) \\ + c^{out} \left( \begin{array}{l} (\bar{\lambda}^2 + 2\mu d_1)(d_1 + d_{-1}) \\ + (\bar{\lambda}^2 + 2\mu(d_0 + d_2 + d_{-1}))(d_2 + d_{-1}) \\ + 2\mu d_{-1}(\bar{\lambda} + \mu) \end{array} \right) \end{array} \right\}, \end{aligned} \tag{3.18}$$

$$\begin{aligned} u(1,1) = {} & \left(1 - \frac{\bar{\lambda}^2}{(\bar{\lambda} + \mu)^2 + \mu^2}\right) d_0 \\ & + \frac{\mu}{(\bar{\lambda} + \mu)\left((\bar{\lambda} + \mu)^2 + \mu^2\right)} \left\{ \begin{array}{l} \bar{\lambda}^2(d_1 + d_2) + 2\mu d_1(\bar{\lambda} + \mu + d_2) \\ + 2\mu d_2(\bar{\lambda} + \mu + d_1) + 2\mu d_1 d_0 \end{array} \right\}. \end{aligned} \tag{3.19}$$

Consequently from Theorems 3.1 and 3.2, the solution to $\mathbf{P_3}$ can be obtained by simply evaluating undominated solutions $(S_1, S_2) = (1,0)$ and $(S_1, S_2) = (1,1)$. Note that we cannot always assume $z(1,1) \geq z(1,0)$ because when $c^e$ is high, choosing $(S_1, S_2) = (1,0)$ may result in very high emergency transportation cost. A formal procedure to solve the two facility single pool problem $\mathbf{P_3}$ is outlined in the following algorithm. Figure 15 is a visual representation of this algorithm.

***Algorithm for the single pool problem***

***Step 1***. *Assign the larger demand region facility as facility '1'.*

***Step 2***. *If* $z(1,1) < z(1,0)$, *then* $(S_1^*, S_2^*) = (1,1)$ *and* $(X_{01}^*, X_{11}^*, X_{21}^*, X_{-11}^*, X_{02}^*, X_{22}^*, X_{12}^*, X_{-12}^*)$ $= (0, d_1, 0, 0, d_0, d_2, 0, d_{-1})$. *Otherwise, go to step 3.*

***Step 3***. *If* $u(1,0) < \alpha\bar{\lambda}$, *then* $(S_1^*, S_2^*) = (1,1)$ *and* $(X_{01}^*, X_{11}^*, X_{21}^*, X_{-11}^*, X_{02}^*, X_{22}^*, X_{12}^*, X_{-12}^*)$ $= (0, d_1, 0, 0, d_0, d_2, 0, d_{-1})$. *Otherwise,* $(S_1^*, S_2^*) = (1,0)$ *and set* $(X_{01}^*, X_{11}^*, X_{21}^*, X_{-11}^*, X_{02}^*, X_{22}^*, X_{12}^*, X_{-12}^*)$ *arbitrarily such that* $X_{11} + X_{12} = d_1$, $X_{21} + X_{22} = d_2$, $X_{01} + X_{02} = d_0$, *and* $X_{-11} + X_{-12} = d_{-1}$.

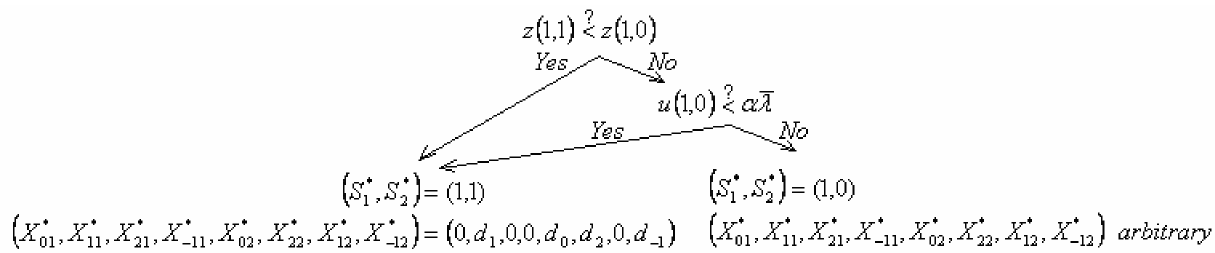



Figure 15. Graphical representation of single pool algorithm

### 2.5 Numerical example

As an example, consider the three scenarios in Table 11 where the system-wide service level is $\alpha = 40\%$ in each scenario. Each scenario follows a different path in the algorithm. In the first scenario, the transportation cost from the central warehouse $(c^e)$ is set high such that $z(1,1) < z(1,0)$. In scenarios 2 and 3, $z(1,1) \geq z(1,0)$, but we vary demand in the overlapping region $(d_0)$. In scenario 2, $d_0$ is so low that $S = (1,0)$ does not satisfy the service level constraint, whereas $d_0$ is high enough in scenario 3 that $S = (1,0)$ is sufficient to satisfy the target service level. Figure 16 illustrates the algorithm for these three scenarios, and in order to focus on the inventory portion of the problem, we set $f = 0$ for the rest of this chapter.

Table 11. Examples of two-facility pools

| | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|
| **System Parameters** | | | |
| $\bar{\lambda}$ | 1.3 | 1.3 | 1.3 |
| $\mu$ | 1 | 1 | 1 |
| $d_0$ | 0.25 | 0.25 | 0.6 |
| $d_1$ | 0.6 | 0.6 | 0.6 |
| $d_2$ | 0.4 | 0.4 | 0.05 |
| $d_{-1}$ | 0.05 | 0.05 | 0.05 |
| **Cost Parameters** | | | |
| $h$ | 3 | 3 | 3 |
| $c^e$ | 9 | 1.5 | 1.5 |
| $c^{in}$ | 0.5 | 0.5 | 0.5 |
| $c^{out}$ | 0.75 | 0.75 | 0.75 |

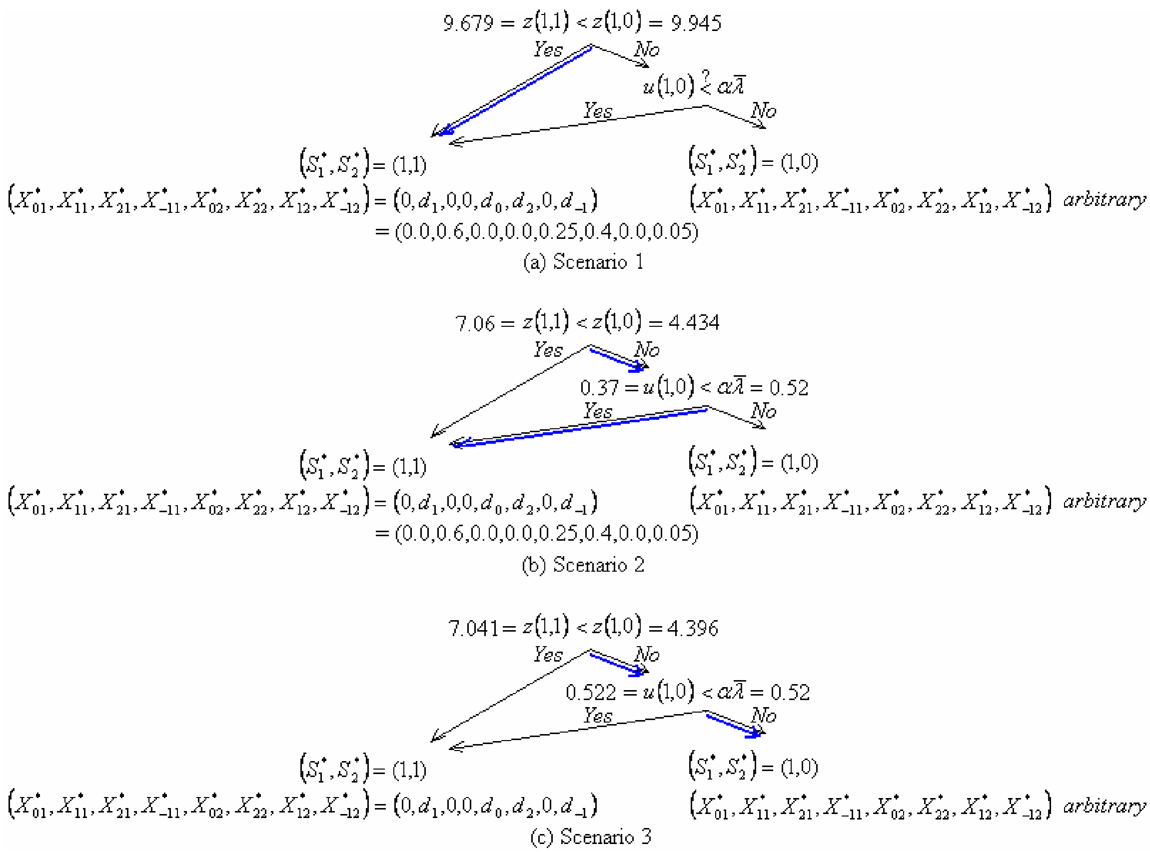



Figure 16. Solution procedure for each scenario in Table 11

An important observation in the single pool problem is that $S = (1,0)$ becomes sufficient to satisfy the target service level when $d_0$ is high. If we measure the degree of inventory sharing based on the idea that $S = (1,0)$ corresponds to more sharing as compared to $S = (1,1)$, then the pool reflects a higher degree of sharing when the demand in the overlapping region (of facilities 1 and 2) is high. Even in the case where $S = (1,1)$, the service level increases with increase in $d_0$ (Figure 17). The plot in Figure 17 corresponds to scenario 2 in Table 11.

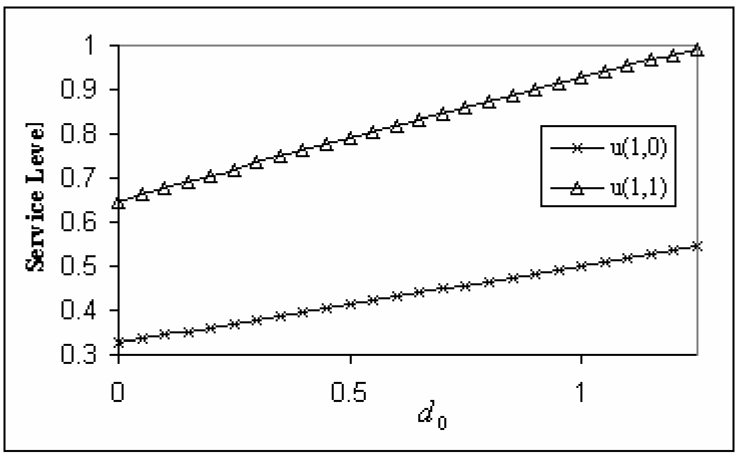



Figure 17. Service level as a function of overlapping demand

## 3 Multiple pool inventory problem with inventory sharing

Consider a network of multiple two facility pools as seen in Figure 18. In addition to the assumptions we make in the single pool problem, let us also assume that each customer belongs to only one pool, i.e., there is no overlap of demand between pools. Also, we assume that a customer cannot be assigned to a facility outside of its pool. Now that we have a system-wide service level constraint over all the pools, we can allow pools to have zero inventory. All the customers in such pools would end up being satisfied by the central warehouse, but this may still prove beneficial from a global point of view.

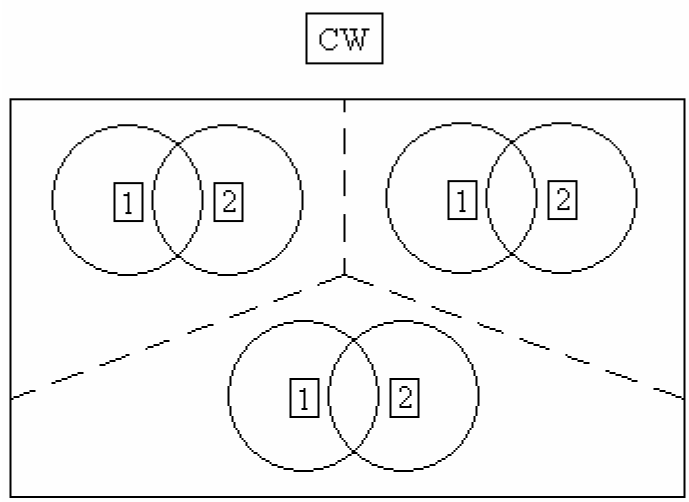


Figure 18. Example of three pools with two facilities in each pool

Suppose the set of pools $P$ is indexed by $p$. We include the index "$p$" to all the parameters and variables (except $\alpha$) to denote the pool they belong to. As a result, the cost of pool $p$ is given by

$$
\begin{aligned}
z(S_{1p}, S_{2p}) = {} & (f+h)(S_{1p}+S_{2p}) \\
& + c^{in}\beta_{1p}(X_{01p}+X_{11p}) + c^{out}\beta_{1p}(X_{21p}+X_{-11p}) \\
& + c^{in}\beta_{2p}(X_{02p}+X_{22p}) + c^{out}\beta_{2p}(X_{12p}+X_{-12p}) \\
& + c^{in}\gamma_{1p}(X_{01p}+X_{21p}) + c^{out}\gamma_{1p}(X_{11p}+X_{-11p}) \\
& + c^{in}\gamma_{2p}(X_{02p}+X_{12p}) + c^{out}\gamma_{2p}(X_{22p}+X_{-12p}) \\
& + c^{e}\theta_{p}\overline{\lambda}_{p},
\end{aligned}
$$

and the contribution of pool $p$ towards service is

$$
\begin{aligned}
u_p(S_{1p}, S_{2p}) = {} & \beta_{1p}(X_{01p}+X_{11p}) + \gamma_{1p}(X_{01p}+X_{21p}) \\
& + \beta_{2p}(X_{02p}+X_{22p}) + \gamma_{2p}(X_{02p}+X_{12p}).
\end{aligned}
$$

## 3.1 **Formulation of multiple pool problem**

The problem of minimizing the total cost of all the pools subject to a service level constraint simply involves combining the single pool problem for each pool subject to a system-wide service level requirement $\alpha$.

**P$_4$:** Minimize

$$\sum_{p\in P} z_p\left(S_{1p}, S_{2p}\right) \tag{3.20a}$$

subject to

$$\sum_{p\in P} u_p\left(S_{1p}, S_{2p}\right) \geq \alpha \sum_{p\in P} \bar{\lambda}_p \tag{3.20b}$$

$$d_{1p} = X_{11p} + X_{12p} \quad p \in P \tag{3.20c}$$

$$d_{2p} = X_{21p} + X_{22p} \quad p \in P \tag{3.20d}$$

$$d_{0p} = X_{01p} + X_{02p} \quad p \in P \tag{3.20e}$$

$$d_{-1p} = X_{-11p} + X_{-12p} \quad p \in P \tag{3.20f}$$

$$X_{01p}, X_{11p}, X_{21p}, X_{-11p}, X_{02p}, X_{22p}, X_{12p}, X_{-12p} \geq 0 \quad p \in P \tag{3.20g}$$

$$S_{1p}, S_{2p} \in \{0,1,2,\ldots\} \quad p \in P. \tag{3.20h}$$

Note that if each pool $p$ has to satisfy a target service level of $\alpha_p$, then the problem can be separated by pool.

Applying the low demand assumption of SPL, a single unit of stock should suffice at each facility. Moreover, Theorems 3.1 and 3.2 show that we do not need to consider $(S_1, S_2) = (0,1)$ in any given pool since it will always be dominated by $(S_1, S_2) = (1,0)$ as long as $d_1 \geq d_2$ for the pool. For each pool, we end up with three feasible solutions; $(S_1, S_2) = (0,0)$, $(S_1, S_2) = (1,0)$, and $(S_1, S_2) = (1,1)$. Therefore, Problem **P$_4$** has at most $3^{|P|}$ feasible solutions since we also show that the allocation decisions are trivial for a given $(S_1, S_2)$ combination (equations (3.16-3.19)).

As the number of pools $|P|$ increases, the solutions space increases exponentially. However, suppose we introduce two binary variables; $V_p$ set to 1 if pool $p$ is upgraded from $(S_1,S_2)=(0,0)$ to $(S_1,S_2)=(1,0)$, and $W_p$ set to 1 if pool $p$ is upgraded from $(S_1,S_2)=(1,0)$ to $(S_1,S_2)=(1,1)$. This leads to an alternative binary knapsack formulation of problem **P₄** where we identify the subset of pools that are "upgraded" to either $(S_1,S_2)=(1,0)$ or $(S_1,S_2)=(1,1)$. The binary knapsack formulation can be formulated as follows:

***Alternative formulation***

**$\mathbf{P_{4'}}$:**Minimize

$$\sum_{p\in P} z_p(0,0)+\sum_{p\in P}\left(z_p(1,0)-z_p(0,0)\right)V_p+\sum_{p\in P}\left(z_p(1,1)-z_p(1,0)\right)W_p \tag{3.20a$'$}$$

subject to

$$\sum_{p\in P} u_p(0,0)+\sum_{p\in P}\left(u_p(1,0)-u_p(0,0)\right)V_p+\sum_{p\in P}\left(u_p(1,1)-u_p(1,0)\right)W_p\geq\alpha\sum_{p\in P}\bar{\lambda}_p \tag{3.20b$'$}$$

$$W_p\leq V_p \quad p\in P \tag{3.21}$$

$$V_p,W_p\in\{0,1\} \quad p\in P, \tag{3.22}$$

where $z_p(0,0), z_p(1,0)$, $z_p(1,1)$, $u_p(0,0), u_p(1,0)$, and $u_p(1,1)$ are all parameters (from equations 3.14-3.19). Note that $u_p(1,1)-u_p(1,0)$ can be algebraically simplified and rewritten as

$$u_p(1,1)-u_p(1,0)=\frac{\mu\left(\left(\bar{\lambda}^2+2\mu\left(d_1+\bar{\lambda}\right)\right)\left(d_0+d_2\right)+2\mu\left(d_1+\mu\right)d_2\right)}{\left(\bar{\lambda}+\mu\right)\left(\left(\bar{\lambda}+\mu\right)^2+\mu^2\right)},$$

which is greater than or equal to zero since each term in the above expression is non-negative. As a result, if $z_p(1,1)<z_p(1,0)$ for some pool $p$, then $W_p=1$ in any optimal solution because $u_p(1,1)\geq u_p(1,0)$.

In an effort to obtain a high quality upper bound on the optimal solution we propose the use of the following greedy heuristic. We sort each pool based on the ratio of the marginal increase in cost divided by the marginal increase in service, and pick the pools with the smallest ratios to be upgraded.

***Greedy heuristic for the multiple pool problem***

***Step 1***. *Initialize* $V_p = 0$, *and* $W_p = 0$ *for every pool* $p \in P$.

***Step 2***. *Sort all the pools in non-decreasing order of* $\dfrac{z_p(1,0) - z_p(0,0)}{u_p(1,0) - u_p(0,0)}$, *and set* $V_p = 1$ *in this order until either* $\sum_{p \in P} (u_p(1,0) - u_p(0,0)) V_p + \sum_{p \in P} (u_p(1,1) - u_p(1,0)) W_p \geq \alpha \sum_{p \in P} \overline{\lambda}_p$ *or* $V_p = 1, \forall p \in P$.

***Step 3***. *Sort all the pools in non-decreasing order of* $\dfrac{z_p(1,1) - z_p(1,0)}{u_p(1,1) - u_p(1,0)}$, *and set* $W_p = 1$ *in this order until* $\sum_{p \in P} (u_p(1,0) - u_p(0,0)) V_p + \sum_{p \in P} (u_p(1,1) - u_p(1,0)) W_p \geq \alpha \sum_{p \in P} \overline{\lambda}_p$.

The reason we first upgrade pools from $(S_1, S_2) = (0,0)$ to $(S_1, S_2) = (1,0)$, and then we consider upgrading them from $(S_1, S_2) = (1,0)$ to $(S_1, S_2) = (1,1)$ as opposed to upgrading them directly from $(S_1, S_2) = (0,0)$ to $(S_1, S_2) = (1,1)$ is because $z_p(1,1) \geq z_p(1,0)$ in most cases.

The worst case bound of the heuristic can be obtained by taking a difference of the LP lower bound and the heuristic upper bound. There are two cases here depending on where the heuristic terminates.

*Case 1*: If the heuristic terminates in step 2, then let $\overline{P}$ denote the subset of $P$ for which $V_p = 1$, and let $\overline{p}$ be the index of the last pool added to $\overline{P}$. In this case, the worst case gap between the LP lower bound and the heuristic upper bound is

$$\frac{z_{\overline{p}}(1,0)-z_{\overline{p}}(0,0)}{u_{\overline{p}}(1,0)-u_{\overline{p}}(0,0)}\left(\sum_{p\in\overline{P}}\left(u_p(1,0)-u_p(0,0)\right)-\alpha\sum_{p\in P}\overline{\lambda}_p\right), \tag{3.23}$$

which is the ratio of the objective function coefficient and constraint coefficient of pool $\overline{p}$ multiplied by the amount by which pool $\overline{p}$ exceeded the right hand side of the constraint.

*Case 2*: If the heuristic passes through step 2 and terminates in step 3, then let $\overline{P}$ denote the subset of $P$ for which $W_p = 1$, and let $\overline{p}$ be the index of the last pool added to $\overline{P}$. The worst case gap in this case is

$$\frac{z_{\overline{p}}(1,1)-z_{\overline{p}}(1,0)}{u_{\overline{p}}(1,1)-u_{\overline{p}}(1,0)}\left(\sum_{p\in P}\left(u_p(1,0)-u_p(0,0)\right)+\sum_{p\in\overline{P}}\left(u_p(1,1)-u_p(1,0)\right)-\alpha\sum_{p\in P}\overline{\lambda}_p\right). \tag{3.24}$$

In set $\overline{P}$, the ratio of the marginal increase in cost divided by the marginal increase in service increases. Therefore, we expect larger gaps as $\left|\overline{P}\right|$ increases.

### 3.2 **Numerical examples**

Another upper bound on the optimal solution of problem $\mathbf{P_{4'}}$ can be obtained by solving each pool separately by setting $\alpha = \alpha_p$ in the single pool algorithm. We observe that a pool could have a solution of $\left(S_1^*, S_2^*\right) = (1,1)$ when solved separately and switch to $\left(S_1^*, S_2^*\right) = (1,0)$ in the combined problem. Conversely, it is possible for a pool to switch from $\left(S_1^*, S_2^*\right) = (1,0)$ in the individual pool problem to $\left(S_1^*, S_2^*\right) = (1,1)$ in the combined problem. This can be seen in the following two pool example (Table 12) with a system-wide target service level of $\alpha = 40\%$.

Table 12. Two pool example

| | $p = 1$ | $p = 2$ |
|---|---|---|
| **System Parameters** | | |
| $\overline{\lambda}$ | 0.75 | 2.5 |
| $\mu$ | 1 | 1 |
| $d_0$ | 0.75 | 1 |
| $d_1$ | 0 | 1.5 |
| $d_2$ | 0 | 0 |
| $d_{-1}$ | 0 | 0 |
| **Cost Parameters** | | |
| $h$ | 2 | 2 |
| $c^e$ | 1.5 | 1.5 |
| $c^{in}$ | 0.5 | 0.5 |
| $c^{out}$ | 7.5 | 7.5 |

The optimal solution of each pool solved individually is $\left(S_{11}^*, S_{21}^*\right) = (1,0)$ and $\left(S_{12}^*, S_{22}^*\right) = (1,1)$ costing a total of 11.22 units for 53.3% service. However, when we solve them in the 2-pool combined problem, the optimal solution turns out to be $\left(S_{11}^*, S_{21}^*\right) = (1,1)$ and $\left(S_{12}^*, S_{22}^*\right) = (1,0)$ which costs only 9.51 units and provides 40.8% service. The upper bound from solving each pool individually typically gets worse for larger problem instances.

Let us now consider a three pool problem (Table 13) and evaluate the greedy heuristic for a system-wide target service level of $\alpha = 40\%$.

Table 13. Three pool example

| | $p = 1$ | $p = 2$ | $p = 3$ |
|---|---|---|---|
| **System Parameters** | | | |
| $\overline{\lambda}$ | 3 | 1 | 1.45 |
| $\mu$ | 1 | 1 | 1 |
| $d_0$ | 2 | 1 | 1.45 |
| $d_1$ | 1 | 0 | 0 |
| $d_2$ | 0 | 0 | 0 |
| $d_{-1}$ | 0 | 0 | 0 |
| **Cost Parameters** | | | |
| $h$ | 1 | 1 | 1 |
| $c^e$ | 1 | 1 | 1 |
| $c^{in}$ | 1 | 1 | 1 |
| $c^{out}$ | 2 | 2 | 2 |

Using the greedy heuristic, the $\dfrac{z_p(1,0) - z_p(0,0)}{u_p(1,0) - u_p(0,0)}$ ratio for pools 1, 2, and 3 are calculated to be 1.333, 2.000, and 1.689, respectively. Therefore, in step 2 we first upgrade pool 1 to $(S_1, S_2) = (1,0)$, followed by pools 3 and 2. The service level achieved is 33.8% which is below the required service level. Calculating the $\dfrac{z_p(1,1) - z_p(1,0)}{u_p(1,1) - u_p(1,0)}$ ratio in step 3, we obtain a value of 2.323 for pool 1, 3.333 for pool 2, and 2.365 for pool 3. The heuristic recommends that we now upgrade pool 1 from $(S_1, S_2) = (1,0)$ to $(S_1, S_2) = (1,1)$ which achieves a service level of 42.9% at a cost of 9.61 units. However, the optimal solution to the three pool problem is $(S_{11}^*, S_{21}^*) = (1,0)$, $(S_{12}^*, S_{22}^*) = (1,0)$, and $(S_{13}^*, S_{23}^*) = (1,1)$ where the total cost is 9.45 units and the service level is 41.5%. Therefore, the greedy heuristic solution remains sub-optimal.

Since the greedy heuristic terminated in step 3, the worst case gap is calculated (from equation 3.24) to be 0.376 units, whereas the actual gap turned out to be 9.61-9.45 = 0.16 units. Incidentally, solving each pool in Table 13 separately gives the same solution as the greedy heuristic. Note that these examples are solved by complete enumeration, but in Section 5 we solve the binary knapsack problem using optimization software and evaluate the performance of the greedy heuristic in an experimental setting.

## 4 Sharing vs No-Sharing

In general, one would expect that sharing is more beneficial than not sharing inventory. However, sharing could sometimes hurt with respect to cost and/or service due to the assumption that every facility has to share its entire inventory. In order to compare sharing versus no-sharing, let us first formulate the no-sharing equivalent formulation of **P₃**. Since we do not allow inventory sharing between facilities, this formulation is obtained by simply setting $\gamma_1 = 0$ and $\gamma_2 = 0$ in formulation **P₃**.

**P₃′:** Minimize

$$z(S_1, S_2) = (f + h)(S_1 + S_2) + c^{in}\beta_1(X_{01} + X_{11}) + c^{out}\beta_1(X_{21} + X_{-11}) + c^{in}\beta_2(X_{02} + X_{22}) + c^{out}\beta_2(X_{12} + X_{-12}) + c^e\theta\bar{\lambda} \tag{3.13a′}$$

Subject to

$$u(S_1, S_2) = \beta_1(X_{01} + X_{11}) + \beta_2(X_{02} + X_{22}) \geq \alpha\bar{\lambda} \tag{3.13b′}$$

$$d_1 = X_{11} + X_{12} \tag{3.13c′}$$

$$d_2 = X_{21} + X_{22} \tag{3.13d′}$$

$$d_0 = X_{01} + X_{02} \tag{3.13e′}$$

$$d_{-1} = X_{-11} + X_{-12} \tag{3.13f′}$$

$$X_{01}, X_{11}, X_{21}, X_{-11}, X_{02}, X_{22}, X_{12}, X_{-12} \geq 0 \tag{3.13g′}$$

$$S_1, S_2 \in \{0,1\}. \tag{3.13h′}$$

Let $z\left(S_1^*, S_2^*\right)_{sharing}$ and $u\left(S_1^*, S_2^*\right)_{sharing}$ be the optimal objective value and service level of $\mathbf{P_{3'}}$ respectively, and let $z\left(S_1^*, S_2^*\right)_{no-sharing}$ and $u\left(S_1^*, S_2^*\right)_{no-sharing}$ be the corresponding values in the no-sharing formulation $\mathbf{P_3}$. In the case where sharing was allowed ($\mathbf{P_3}$), we observed that demand allocation was trivial for any given stock level. This is partially true in the case of no-sharing. If $\left(S_1^*, S_2^*\right) = (0,0)$ or $\left(S_1^*, S_2^*\right) = (1,0)$, then $z\left(S_1^*, S_2^*\right)_{sharing}$ and $u\left(S_1^*, S_2^*\right)_{sharing}$ are independent of the demand allocation variables (just like in the sharing case). Therefore,

$$z(0,0)_{sharing} = z(0,0)_{no-sharing},$$

$$u(0,0)_{sharing} = u(0,0)_{no-sharing},$$

$$z(1,0)_{sharing} = z(1,0)_{no-sharing}, \text{ and}$$

$$u(1,0)_{sharing} = u(1,0)_{no-sharing}.$$

In other words, sharing does not benefit or harm when $\left(S_1^*, S_2^*\right) = (0,0)$ or $\left(S_1^*, S_2^*\right) = (1,0)$.

However, in the event that $\left(S_1^*, S_2^*\right) = (1,1)$, $z(1,1)_{sharing}$ and $u(1,1)_{sharing}$ are not independent of the demand allocation variables. Moreover, unlike the no-sharing case, there does not exist dominance of certain demand allocation variables in $z(1,1)_{sharing}$ and $u(1,1)_{sharing}$. Therefore, the demand allocation for $\left(S_1, S_2\right) = (1,1)$ can only be obtained by solving the non-linear optimization problem in $\mathbf{P_{3'}}$. Nevertheless, we can still find conditions in which sharing is more beneficial than no-sharing for $\left(S_1, S_2\right) = (1,1)$ stock levels. We know that sharing is beneficial with respect to service only if $u(1,1)_{sharing} \geq u(1,1)_{no-sharing}$ and with respect to cost only if $z(1,1)_{sharing} \leq z(1,1)_{no-sharing}$. The formulae for these conditions are given in Appendix G.

Figure 19 and Figure 20 illustrate that sharing is only beneficial under certain conditions. In Figure 19, we plot the service level as a function of demand in the overlapping region of both facilities $(d_0)$. The rest of the parameters for this plot are $d_1 = 0.6$, $d_2 = 0.1$, $d_{-1} = 0.1$, and $\mu = 12$.

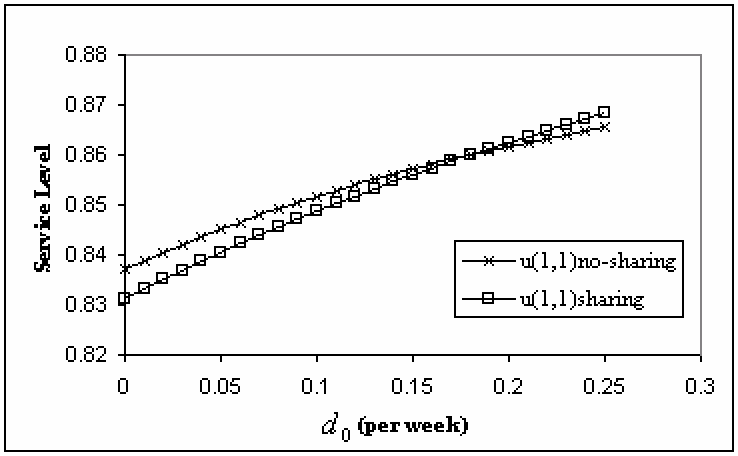



Figure 19. Sharing hurts with respect to service level in some cases

Similarly, in Figure 20 we plot the total cost as a function of the replenishment rate $(\mu)$. For this plot, we set $d_1 = 0.6$, $d_2 = 0.1$, $d_0 = 4.0$, and $d_{-1} = 0.1$.

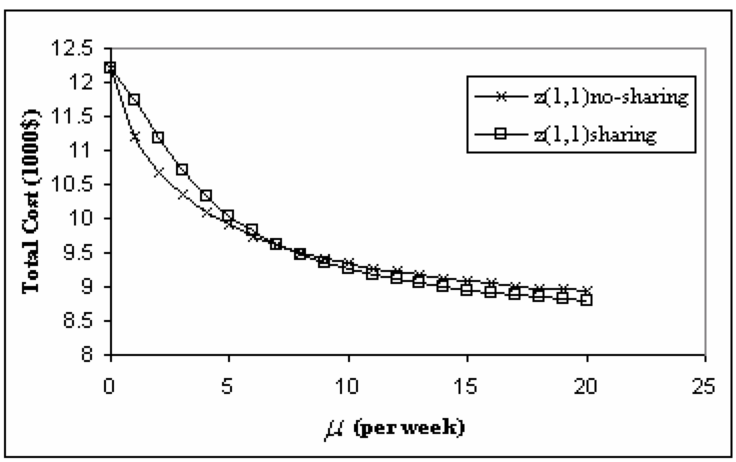



Figure 20. Sharing hurts with respect to total cost in some cases

In summary, inventory sharing is beneficial when a large number of customers exist in the overlapping region of the time windows of both facilities and when each facility has a high replenishment rate of inventory. This is because, when most of the demand exists outside the overlapping region of both facilities, facilities end up having to share inventory with customers that do not contribute to their service level. Similarly, low replenishment rates cause facilities to remain out of stock for longer periods of time because the facilities are forced to share inventory with all the customers in the pool.

We mentioned earlier that demand allocation is not trivial for all given stock levels. Therefore, the no-sharing problem remains non-linear in the no-sharing case.

## 5 Computational results

In this section, we run some experiments on the formulation and heuristic from Section 4. The $\mathbf{P_{4'}}$ formulation is modeled in MOSEL and solved using branch and bound with Xpress MP as the solver. The multiple pool problem can be solved in a significantly short amount of time. Using a Pentium M 1.4 GHz processor with 512 MB of RAM, we can solve the optimization problem with up to 5000 pools in less than a minute.

Consider a network of 50 pools, with each pool having two facilities. In order to identify system parameters that induce a greater degree of inventory sharing, we conduct a controlled set of experiments (see Appendix H for details) with the following factors with their corresponding levels.

- $h = \{0,5,10\}$
- $c^{in} = \{0,0.5,1.0\}$
- $c^{out} = \{0,1,2\}$
- $c^{e} = \{0,1.5,3.0\}$
- $\alpha = \{0.75,0.85\}$
- $d_1 = \{[0,0.05],[0.05,0.1]\}$
- $d_2 = \{[0,0.05],[0.05,0.1]\}$
- $d_0 = \{[0,0.05],[0.05,0.1]\}$
- $d_{-1} = \{[0,0.01],[0.01,0.02]\}$

Note that we only run those combinations where $c^{in} \le c^{out}$ and we set $f = 0$ to highlight the effects of inventory sharing. All costs are in 1000s of \$, and demand parameters are in mean rates per week while the replenishment rate at each facility is set to $\mu = 1$ unit per week. Before running the experiment over different parameter values, we generate a random set of demand values for $d_1$, $d_2$, $d_0$, and $d_{-1}$. We then maintain this demand set throughout the experiment so that we can compare the results of the experiments.

The input parameters are organized as follows.

- Holding cost of inventory at each facility – denoted by "$h$"
- Transportation cost of demand satisfied within the time window of a facility – denoted by "$c^{in}$"
- Transportation cost of demand satisfied outside the time window of a facility – denoted by "$c^{out}$"
- Transportation cost of demand satisfied as an emergency shipment from the central warehouse – denoted by "$c^{e}$"
- Target system wide service level – denoted by "$\alpha$"
- Total demand rate from customers only within the time window of facility 1 – denoted by "$d_1$"
- Total demand rate from customers only within the time window of facility 2 – denoted by "$d_2$"
- Total demand rate from customers that are within the time window of both facility 1 and facility 2 – denoted by "$d_0$"
- Total demand rate from customers that are not within the time window of any facility – denoted by "$d_{-1}$"

The output is organized as follows.

- Number of pools with $(S_{1p}, S_{2p}) = (0,0)$ – denoted by "(0,0)"

- Number of pools with $(S_{1p}, S_{2p}) = (1,0)$ – denoted by "(1,0)"
- Number of pools with $(S_{1p}, S_{2p}) = (1,1)$ – denoted by "(1,1)"
- Optimal objective value – denoted by "Opt obj"
- Status of optimal solution at termination – denoted by "Status"
- Time to obtain optimal solution – denoted by "Opt sol time"
- Heuristic objective value – denoted by "H obj"
- Time to obtain heuristic solution – denoted by "H sol time"
- Gap between heuristic solution and optimal solution as a fraction of the optimal solution – denoted by "H-Opt gap"

***Performance of greedy heuristic for the multiple pool problem***

Analysis of the results reveals that the heuristic performs well in instances where the holding cost is positive. See Table 14 for a subset of some experiments with zero holding cost and another subset with positive holding cost (where $c^{in} = 1$, $c^{out} = 2$, and $c^{e} = 3$). Among the 672 instances where holding cost is positive, the heuristic is on average within 0.12% of the optimal solution, and the maximum gap is 1.8%.

Table 14. Snapshot of experiments varying $h$

| Input Parameters | | | | | | Output | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Opt sol time | H obj | H sol time | H-Opt gap |
| 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 10.31 | 0.04 | 12.01 | 0 | 0.1646 |
| 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 11.39 | 0.031 | 12.58 | 0.01 | 0.1052 |
| 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 12.89 | 0.03 | 15.24 | 0 | 0.1826 |
| 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 13.98 | 0.03 | 15.68 | 0 | 0.122 |
| 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 4.569 | 0.04 | 4.862 | 0 | 0.0643 |
| 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.926 | 0.03 | 7.662 | 0 | 0.1063 |
| 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 7.97 | 0.04 | 8.062 | 0 | 0.0115 |
| 5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 402.1 | 0.06 | 402.1 | 0 | 0 |
| 5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 437.6 | 0.06 | 437.6 | 0 | 1E-05 |
| 5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 395.3 | 0.06 | 395.3 | 0 | 0 |
| 5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 425.8 | 0.06 | 425.8 | 0 | 0 |
| 5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 380 | 0.06 | 380 | 0 | 0 |
| 5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0 |
| 5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 357.8 | 0.05 | 357.8 | 0 | 0 |
| 5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 473.1 | 0.05 | 473.1 | 0 | 1E-05 |

This is because when the holding cost is zero, a large number of pools end up with two units of stock and the greedy heuristic terminates in step 2. As a result, many pools have $W_p = 1$, and the set $\overline{P}$ is quite large which in turn causes a larger worst case gap (Section 3.2).

We observe (in Table 15) that the number of pools with two units of stock increases with increase in $\alpha$, $d_1$, $d_2$, and $d_{-1}$. This serves as a validity check for the model, because we expect that more inventory would be required to satisfy more demand and/or higher target service levels. Another important observation from Table 15 is that the number of pools with two units of stock decreases with increase in $d_0$. Therefore, as the demand in the overlapping region of the time window of both facilities increases, the pool can afford to reduce inventory because of a greater degree of inventory sharing. This reinforces the observation in Figure 17.

Table 15. Snapshot of experiments varying $\alpha$, $d_1$, $d_2$, $d_0$, and $d_{-1}$

| Input Parameters | | | | | | Output | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Opt sol time | H obj | H sol time | H-Opt gap |
| 5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 295.5 | 0.061 | 300.5 | 0 | 0.0167 |
| 5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 381 | 0.06 | 381 | 0 | 0 |
| 5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 273.7 | 0.05 | 273.7 | 0.01 | 0 |
| 5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 324.3 | 0.05 | 324.3 | 0.01 | 0 |
| 5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 402.1 | 0.06 | 402.1 | 0 | 0 |
| 5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 437.6 | 0.06 | 437.6 | 0 | 1E-05 |
| 5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 395.3 | 0.06 | 395.3 | 0 | 0 |
| 5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 425.8 | 0.06 | 425.8 | 0 | 0 |
| 5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 380 | 0.06 | 380 | 0 | 0 |
| 5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0 |
| 5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 357.8 | 0.05 | 357.8 | 0 | 0 |
| 5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 473.1 | 0.05 | 473.1 | 0 | 1E-05 |
| 5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 475.8 | 0.061 | 475.8 | 0 | 2E-05 |
| 5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0 |
| 5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 473.6 | 0.06 | 473.6 | 0 | 0 |
| 5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 514 | 0.04 | 514 | 0.01 | 0 |

All the cost parameters ( $h$ , $c^{in}$ , $c^{out}$ , and $c^{e}$ ) have varying effects on the number of pools with two units of stock. In general we would expect that as cost increases, fewer pools would have two units of stock. However, varying these parameters sometime causes $z(1,1) < z(1,0)$, i.e, it becomes cheaper to stock two units in the pool than just one unit because of relatively high transportation cost to the central warehouse $\left(c^{e}\right)$.

# 6 Conclusions

In the literature, fill rates have been estimated through an iterative process. However, when we know that service parts in SPL have low demand we are able to simplify the steps of estimation. Furthermore, by limiting the number of facilities in a pool to two, we are able to estimate fill rates by simultaneously solving two linear equations. These equations are solved with demand allocation as a parameter.

Using the fill rate estimation equations we have been able to formulate the inventory optimization problem for a single pool with inventory sharing between the two facilities in the pool. In this case, demand allocation is a variable as well. Under the low demand assumption, we notice that there exist only two feasible inventory stocking solutions, and the demand allocation is trivial for each of them. Therefore, the single pool problem can be solved by simply comparing the two solutions.

The multiple pool problem is simply a combination of each of the individual pool problems with a system-wide service level constraint that ties all the pools together. Although the solution space increases exponentially with the number of pools, we have formulated an equivalent binary knapsack problem to solve the multiple pool problem. Finally, we have outlined a greedy heuristic to obtain an upper bound on the problem.

Computational results show that the greedy heuristic performs well in cases where the holding cost is not free. On average, the heuristic solution is within 0.12% of the optimal solution. Furthermore, we observe that a greater degree of sharing occurs when a large number of customers are located in the area overlapping the time window of both facilities and when the replenishment rate is high at each facility. Due to this greater degree of sharing, lower stock levels are sufficient to achieve the same target service levels.

While measuring the benefit of inventory sharing, we observe that when the demand in the overlapping region of both facilities is low and/or the replenishment rate is low, then inventory sharing hurts the system. This is due to the assumption that all facilities are forced to share their inventory with the other facilities in the pool.

# Chapter 4: Dedicated Facilities and Inventory Sharing

In Chapter 2, we studied the impact of allowing some customers to have facilities dedicated to themselves, and in Chapter 3 we researched the idea of inventory sharing between shared facilities. However, most companies in the spare parts industry have a combination of both. In other words, they would have some customers with demand and service requirements high enough to justify opening a dedicated facility, and on the other hand they would have other customers with demand and service requirements low enough to justify inventory sharing between the facilities that they are assigned to. Therefore, in this chapter, we formulate the inventory sharing problem while allowing some customers to have dedicated facilities on-site. In the case of multiple pools, we also identify a greedy heuristic that provides a good upper bound. Finally, we compare the performance of the model in the literature with the models in this dissertation.

## 1 Single pool inventory sharing problem with dedicated facilities

Consider a single pool of two facilities. These facilities will be addressed as "shared facilities" from now on, in order to distinguish them from the customers with "dedicated facilities". Demand of each customer is assumed to be low enough that a single unit of base stock level at the shared facility is sufficient to satisfy demand during lead time. In this way, each shared facility can be opened or closed and stocked with at most 1 unit each. We also continue to assume that a single unit of base stock level at a dedicated facility is sufficient to render 100% service to the demand of the customer on-site.

### 1.1 **Notation**

In addition to the notation from Chapter 3, let $J$ be the set of customers with potential dedicated facilities (red flagged customers in Figure 21). Furthermore, we define the following notation:

$J_1$ subset of $J$ that are only within the time window of shared facility 1

$J_2$ subset of $J$ that are only within the time window of shared facility 2

$J_0$ subset of $J$ that are within the time window of both shared facilities 1 and 2

$J_{-1}$ subset of $J$ that are not within the time window of shared facility 1 or 2

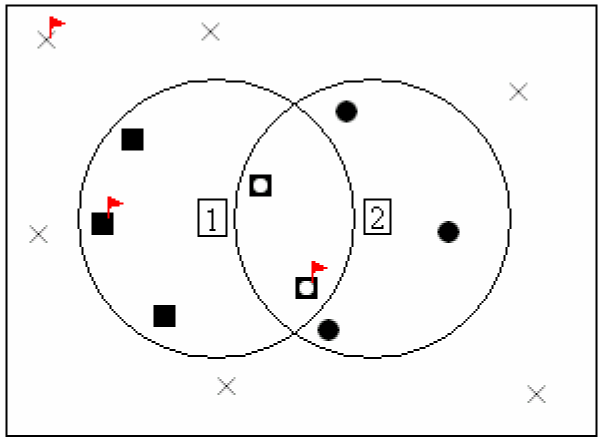



Figure 21. Single pool with dedicated facilities

Suppose $\hat{d}_j$ is the mean demand rate per unit time of customer $j$ and $\hat{f}$ is the fixed cost of opening and operating a dedicated facility per unit time, and we introduce a new decision variable $\hat{Y}_j$ which is set to 1 if a dedicated facility is opened at the location of customer $j$. So the red flagged customers could either be assigned to themselves by opening a dedicated facility on-site, or their demand could be assigned to either shared facility 1 or shared facility 2.

The rest of the customers (that are not potential dedicated facilities), however, can only be assigned to one of the two shared facilities. Therefore, we do not need to know the exact location of these customers. All we need to know is whether they are only within the time window of shared facility 1, or only within the time window of shared facility 2, or within the time window of both shared facilities, or outside the time window of both shared facilities. Based on this, the demand of these customers (that are not potential dedicated facilities) can be aggregated to obtain $d_1$, $d_2$, $d_0$, and $d_{-1}$.

## 1.2 **Formulation of a single pool problem with dedicated facilities**

This formulation is simply an extension of the single pool inventory sharing formulation in Chapter 3. Our approach to solve the single pool problem with dedicated facilities is that we first aggregate the demand of all the customers that are not potential dedicated facilities to obtain $d_1$, $d_2$, $d_0$, and $d_{-1}$ and formulate the single pool inventory sharing problem. In addition to the fixed costs, holding costs, and transportation costs of each of the shared facilities, the objective function now includes a fixed and holding cost per unit for each dedicated facility. Moreover, the additional demand of each customer with a potential dedicated facility needs to be satisfied as well. The formulation is given as follows:

**$\mathbf{P_5}$:** Minimize

$$\begin{aligned} z(S_1,S_2) = {} & (f+h)(S_1+S_2) + (\hat{f}+h)\sum_{j\in J}\hat{Y}_j \\ & + c^{in}\beta_1(X_{01}+X_{11}) + c^{out}\beta_1(X_{21}+X_{-11}) + c^{in}\beta_2(X_{02}+X_{22}) + c^{out}\beta_2(X_{12}+X_{-12}) \\ & + c^{in}\gamma_1(X_{01}+X_{21}) + c^{out}\gamma_1(X_{11}+X_{-11}) + c^{in}\gamma_2(X_{02}+X_{12}) + c^{out}\gamma_2(X_{22}+X_{-12}) \\ & + c^{e}\theta\left(\bar{\lambda} + \sum_{j\in J}(1-\hat{Y}_j)\hat{d}_j\right) \end{aligned} \tag{4.1a}$$

subject to

$$\begin{aligned} u(S_1,S_2) = {} & \beta_1(X_{01}+X_{11}) + \gamma_1(X_{01}+X_{21}) \\ & + \beta_2(X_{02}+X_{22}) + \gamma_2(X_{02}+X_{12}) + \sum_{j\in J}\hat{d}_j\hat{Y}_j \ge \alpha\left(\bar{\lambda} + \sum_{j\in J}\hat{d}_j\right) \end{aligned} \tag{4.1b}$$

$$d_1 + \sum_{j\in J_1}\hat{d}_j(1-\hat{Y}_j) = X_{11} + X_{12} \tag{4.1c}$$

$$d_2 + \sum_{j\in J_2}\hat{d}_j(1-\hat{Y}_j) = X_{21} + X_{22} \tag{4.1d}$$

$$d_0 + \sum_{j\in J_0}\hat{d}_j(1-\hat{Y}_j) = X_{01} + X_{02} \tag{4.1e}$$

$$d_{-1} + \sum_{j \in J_{-1}} \hat{d}_j \left(1 - \hat{Y}_j\right) = X_{-11} + X_{-12} \tag{4.1f}$$

$$X_{01}, X_{11}, X_{21}, X_{-11}, X_{02}, X_{22}, X_{12}, X_{-12} \geq 0 \tag{4.1g}$$

$$\hat{Y}_j \in \{0,1\} \quad \forall j \in J \tag{4.1h}$$

$$S_1, S_2 \in \{0,1\}, \tag{4.1i}$$

where $d_1$, $d_2$, $d_0$, $d_{-1}$, and $\overline{\lambda}$ are aggregated based on demand of customers that are not potential dedicated facility locations. The fill rates $\theta, \beta_1, \beta_2, \gamma_1$, and $\gamma_2$ are now functions of $\overline{\lambda} + \sum_{j \in J} \hat{d}_j \left(1 - \hat{Y}_j\right)$.

The service level constraint (4.1b) reflects that each dedicated facility contributes 100% towards the target service level. This is due to the low demand nature of parts in SPL. Constraints (4.1c), (4.1d), (4.1e), and (4.1f) now include the demand of customers with potential dedicated facilities. In other words, either a dedicated facility should be opened at the customer location, or the demand of that particular customer should be assigned to one of the shared facilities.

In Chapter 3, we defined $d_1$ as the total demand only within the time window of shared facility 1, and $d_2$ as the total demand only within the time window of shared facility 2. We also prove that for given stock levels, the demand allocation is trivial as long as we maintain $d_1 \geq d_2$. However, now that the new value for total demand only within the time window of shared facility 1 is $d_1^{'} = d_1 + \sum_{j \in J_1} \hat{d}_j \left(1 - \hat{Y}_j\right)$, and the total demand only within the time window of shared facility 2 is $d_2^{'} = d_2 + \sum_{j \in J_2} \hat{d}_j \left(1 - \hat{Y}_j\right)$, we cannot guarantee $d_1^{'} \geq d_2^{'}$ since they are now dependent on variables $\hat{Y}_j$. Nevertheless, for a given $\hat{Y}_j$ solution the result still holds because we can calculate the values of $d_1^{'}$ and $d_2^{'}$, and switch the indices ('1' and '2') in case $d_1^{'} < d_2^{'}$. Therefore, we can still enumerate all the 0-1 combinations of each $\hat{Y}_j$ variable and preserve the fact that demand allocation is trivial for given stock levels.

Let $R$ be the set of 0-1 combinations of closing or opening each potential dedicated facility. The problem size $|R| = 2^{|J|}$ grows exponentially with respect to $|J|$. This issue is addressed in Section 2 of this chapter.

The question now arises whether we can eliminate any combinations based on dominance, and the answer is no. This is because opening a dedicated facility always provides a higher service level than assigning the demand of that customer to a shared facility, but from a cost point of view opening or closing a dedicated facility could benefit or harm depending on the size of the customer's demand. In Section 1.4 of this chapter, we provide certain conditions on customer demand under which assigning this additional demand to the existing stock at the shared facilities might prove beneficial from a cost perspective.

For each combination $(r \in R)$, we can calculate $z_r(S_1, S_2)$ as the total cost of stocking $(S_1, S_2)$ at the shared facilities and opening dedicated facilities corresponding to combination $r$, and $u_r(S_1, S_2)$ as the service level when stocking $(S_1, S_2)$ at the shared facilities and opening dedicated facilities corresponding to combination $r$.

For example, suppose there are three potential dedicated facilities $J = \{1,2,3\}$ where $J_1 = \{1,2\}$, $J_2 = \{\ \}$, $J_0 = \{\ \}$, and $J_{-1} = \{3\}$. If we open dedicated facilities 1 and 3, i.e., $r = (1,0,1)$, then $z_r(S_1, S_2)$ and $u_r(S_1, S_2)$ are calculated as follows. Since dedicated facility 2 is closed, its demand is added to demand region 1 (since $J_1 = \{1,2\}$). Therefore, we first calculate the new value for total demand of customers only within the time window of facility 1 as $d_1^{'} = d_1 + \hat{d}_2$ and the new total demand to be satisfied by the pool as $\bar{\lambda}' = \bar{\lambda} + \hat{d}_2$. Then,

$$z_r(0,0) = z(0,0) + 2(\hat{f} + h),$$
$$u_r(0,0) = u(0,0) + (\hat{d}_1 + \hat{d}_3),$$
$$z_r(1,0) = z(1,0) + 2(\hat{f} + h),$$
$$u_r(1,0) = u(1,0) + (\hat{d}_1 + \hat{d}_3),$$
$$z_r(1,1) = z(1,1) + 2(\hat{f} + h),$$
$$u_r(1,1) = u(1,1) + (\hat{d}_1 + \hat{d}_3).$$

where $z(0,0)$, $u(0,0)$, $z(1,0)$, $u(1,0)$, $z(1,1)$, and $u(1,1)$ are calculated by replacing $d_1$ with $d_1^{'}$, and $\bar{\lambda}$ with $\bar{\lambda}'$ in equations (3.14-3.19) of Chapter 3.

We now define a new binary variable $Y_r(S_1, S_2)$ which is set to 1 if $(S_1, S_2)$ are stocked at the shared facility and dedicated facilities are opened according to combination $r$. An alternative formulation to solve the single pool inventory sharing problem with dedicated facilities is given below.

***Alternative formulation***

**P$_{5'}$:**Minimize

$$\sum_{r \in R} z_r(0,0)Y_r(0,0) + z_r(1,0)Y_r(1,0) + z_r(1,1)Y_r(1,1) \qquad (4.1a')$$

subject to

$$\sum_{r \in R} u_r(0,0)Y_r(0,0) + u_r(1,0)Y_r(1,0) + u_r(1,1)Y_r(1,1) \geq \alpha\left(\bar{\lambda} + \sum_{j \in J} \hat{d}_j\right) \qquad (4.1b')$$

$$\sum_{r \in R} Y_r(0,0) + Y_r(1,0) + Y_r(1,1) = 1 \qquad (4.1j)$$

$$Y_r(0,0), Y_r(1,0), Y_r(1,1) \in \{0,1\} \quad \forall r \in R. \qquad (4.1k)$$

Among all the $Y_r(0,0)$, $Y_r(1,0)$, and $Y_r(1,1)$ variables, constraint (4.1j) sets all but one to zero. This ensures that only one stock level combination and one dedicated facility vector combination is chosen. The total cost (4.1a′) and the service level (4.1b′) are then evaluated accordingly. As we mentioned earlier, the fact that the problem size grows exponentially as $|J|$ increases will be addressed when formulating and solving the multiple pool case of this problem (Section 2).

By the way, since we calculate the $z_r(S_1, S_2)$ and $u_r(S_1, S_2)$ values for each $r \in R$ ahead of time, we can still continue to ignore the $(S_1, S_2) = (0,1)$ setting because we know which demand region is larger, and can rename it as the region belonging to shared facility 1.

### 1.3 **Special case: Single dedicated facility**

In an effort to gain insight into the problem, we analyze the case with $|J| = 1$. In other words, there exists only one customer with a potential dedicated facility. Demand from the remaining customers are aggregated into demand regions $d_1$, $d_2$, $d_0$, and $d_{-1}$ based on their locations, and let us define $\mathbf{d} = [d_1 \quad d_2 \quad d_0 \quad d_{-1}]$ as the vector of demand regions. Suppose the demand of the customer with the potential dedicated facility is $\hat{d}$, then let $\mathbf{d}'$ be the demand vector with $\hat{d}$ added to the appropriate demand region. Based on this notation, $z(S_1, S_2)_{\mathbf{d}}$ and $u(S_1, S_2)_{\mathbf{d}}$ denote the objective function and constraint values calculated using demand vector $\mathbf{d}$, and $z(S_1, S_2)_{\mathbf{d}'}$ and $u(S_1, S_2)_{\mathbf{d}'}$ are calculated using demand vector $\mathbf{d}'$. Furthermore, let us also define $\tilde{z}_{\mathbf{d}}$ and $\tilde{u}_{\mathbf{d}}$ as the optimal objective value and constraint value (respectively) when the dedicated facility is opened, and let $\tilde{z}_{\mathbf{d}'}$ and $\tilde{u}_{\mathbf{d}'}$ be the corresponding values when the dedicated facility is closed.

If $\hat{Y}$ is the decision variable whether or not to open the dedicated facility, then the optimal solution can be obtained by comparing two alternatives; open the dedicated facility, or close the dedicated facility and assign the demand of the customer on-site to one of the shared facilities. This can be done because for a given demand vector, we know the optimal stock level and demand allocation (from the single pool algorithm of Section 2.4 in Chapter 3). This procedure can be written as the following algorithm.

***Algorithm for the single pool, single dedicated facility problem***

***Step 1***. *Add $\hat{d}$ to the appropriate demand region to obtain $\mathbf{d}'$, and swap indices '1' and '2' if $d_1 < d_2$ in $\mathbf{d}'$.*

***Step 2***. *Evaluate the option of opening the dedicated facility (step 2.1) and the option of closing it (step 2.2).*

***Step 2.1*** *If $z(1,1)_{\mathbf{d}} < z(1,0)_{\mathbf{d}}$, then go to step 2.1.1. Otherwise, if $u(1,0)_{\mathbf{d}} + \hat{d} < \alpha\left(\overline{\lambda} + \hat{d}\right)$, then go to step 2.1.1. Otherwise, go to step 2.1.2.*

***Step 2.1.1*** *Set $\tilde{z}_{\mathbf{d}} = z(1,1)_{\mathbf{d}} + \hat{f} + h$ and $\tilde{u}_{\mathbf{d}} = u(1,1)_{\mathbf{d}} + \hat{d}$.*

***Step 2.1.2*** *Set $\tilde{z}_{\mathbf{d}} = z(1,0)_{\mathbf{d}} + \hat{f} + h$ and $\tilde{u}_{\mathbf{d}} = u(1,0)_{\mathbf{d}} + \hat{d}$.*

***Step 2.2*** *If $z(1,1)_{\mathbf{d}'} < z(1,0)_{\mathbf{d}'}$, then go to step 2.2.1. Otherwise, if $u(1,0)_{\mathbf{d}'} < \alpha\left(\overline{\lambda} + \hat{d}\right)$, then go to step 2.2.1. Otherwise, go to step 2.2.2.*

***Step 2.1.1*** *Set $\tilde{z}_{\mathbf{d}'} = z(1,1)_{\mathbf{d}'}$ and $\tilde{u}_{\mathbf{d}} = u(1,1)_{\mathbf{d}'}$.*

***Step 2.1.2*** *Set $\tilde{z}_{\mathbf{d}} = z(1,0)_{\mathbf{d}'}$ and $\tilde{u}_{\mathbf{d}} = u(1,0)_{\mathbf{d}'}$.*

***Step 3***. *Compare alternatives as follows. If $\tilde{z}_{\mathbf{d}'} < \tilde{z}_{\mathbf{d}}$ and $\tilde{u}_{\mathbf{d}'} \geq \alpha\left(\overline{\lambda} + \hat{d}\right)$ then set $\hat{Y} = 0$. Otherwise, set $\hat{Y} = 1$.*

Using the algorithm with cost parameters (shown in Table 16), we solve the single pool problem for a system-wide target service level of $\alpha = 80\%$ while varying the demand of the single dedicated facility. The three scenarios are $\hat{d} = 0$, $\hat{d} = 0.1$, and $\hat{d} = 0.5$ (Table 17).

Table 16. Input cost parameters for special case

| Cost Parameters | |
|---|---|
| $f$ | 2 |
| $\hat{f}$ | 1 |
| $h$ | 0.5 |
| $c^e$ | 1.5 |
| $c^{in}$ | 0.5 |
| $c^{out}$ | 0.75 |

Table 17. Additional demand scenarios

| **System Parameters** | **Scenario 1** | **Scenario 2** | **Scenario 3** |
|---|---|---|---|
| $\overline{\lambda}$ | 1 | 1 | 1 |
| $\mu$ | 12 | 12 | 12 |
| $d_0$ | 0.25 | 0.25 | 0.25 |
| $d_1$ | 0.6 | 0.6 | 0.6 |
| $d_2$ | 0.1 | 0.1 | 0.1 |
| $d_{-1}$ | 0.05 | 0.05 | 0.05 |
| $\hat{d}$ | 0 | 0.1 | 0.5 |

| Solution | Stock (1,1) | Stock (1,0) Open dedicated facility | Stock (1,0) Close dedicated facility |
|---|---|---|---|
| Total Cost (1000$) | 5.52 | 4.611 | 3.45 |
| Service Level | 0.914 | 0.804 | 0.8 |

In general, we expect the service level to decrease and total cost to increase as $\hat{d}$ increases because of a higher service level requirement, and potentially higher stock levels to fulfill the additional demand. However, if we compare scenarios 1, 2 and 3 in Table 17, we can see that the additional demand decreases the total cost. In order to ensure that this behavior is not simply an outcome of the heuristic, we now explore the conditions under which such non-intuitive results occur.

In the case where (1,0) units are stocked at the shared facilities, the total cost decreases with increase in additional demand $\hat{d}$ if $z(1,0)_{\mathbf{d}'} \le z(1,0)_{\mathbf{d}}$. This can be rewritten as

$$0 \le \hat{d} \le \frac{1}{c^e\left(\overline{\lambda} + \mu\right)}\left(\mu\left(c^{out} - c^{in}\right)\left(d_2 - d_{-1}\right) - \overline{\lambda}c^e\left(\overline{\lambda} + 2\mu\right) - \mu^2 c^{in}\right).$$

This range exists only when the right hand side of the inequality

$$\frac{1}{c^e\left(\overline{\lambda} + \mu\right)}\left(\mu\left(c^{out} - c^{in}\right)\left(d_2 - d_{-1}\right) - \overline{\lambda}c^e\left(\overline{\lambda} + 2\mu\right) - \mu^2 c^{in}\right) \ge 0.$$

Solving the above inequality with respect to $c^{out}$ by replacing all the other parameters with those in Table 16 and Table 17, we observe that this range exists for $c^{out} > 62.4$. Figure 22 shows this decrease in cost with respect to additional demand ($c^{out} = 80$ in Figure 22).

Similarly, in the case where (1,0) units are stocked at the shared facilities, service increases with increase in additional demand $\hat{d}$ if $u(1,0)_{\mathbf{d}'} \ge u(1,0)_{\mathbf{d}}$, which in terms of $\hat{d}$ is given by

$$0 \le \hat{d} \le \frac{\left(\overline{\lambda} + \mu\right)\left(d_2 + d_{-1}\right)}{\left(d_0 + d_1\right)} - \overline{\lambda}.$$

In order for this range to exist, we require the right hand side of the inequality

$$\frac{\left(\overline{\lambda} + \mu\right)\left(d_2 + d_{-1}\right)}{\left(d_0 + d_1\right)} - \overline{\lambda} \ge 0.$$

For the system parameters in Table 17, this range exists when $\mu > 5.2$. Figure 23 shows increase in service within this range (where $\mu = 12$).

Although these are theoretical possibilities, it is highly unlikely that $c^{out} = 62.5$ would be so much larger than $c^{in} = 0.5$. Moreover, a replenishment rate of $\mu = 5.2$ per week is also not very likely. Therefore, such cases may not occur in practice, but we cannot ignore these possibilities while building algorithms and heuristics to solve this problem.

Such non-intuitive results were not observed in the case where (1,1) units are stocked at the shared facilities.

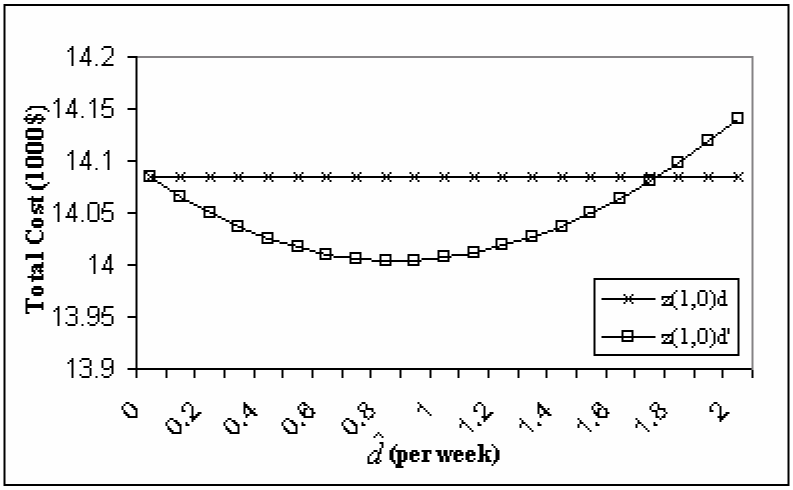



Figure 22. Reduction in cost with additional demand

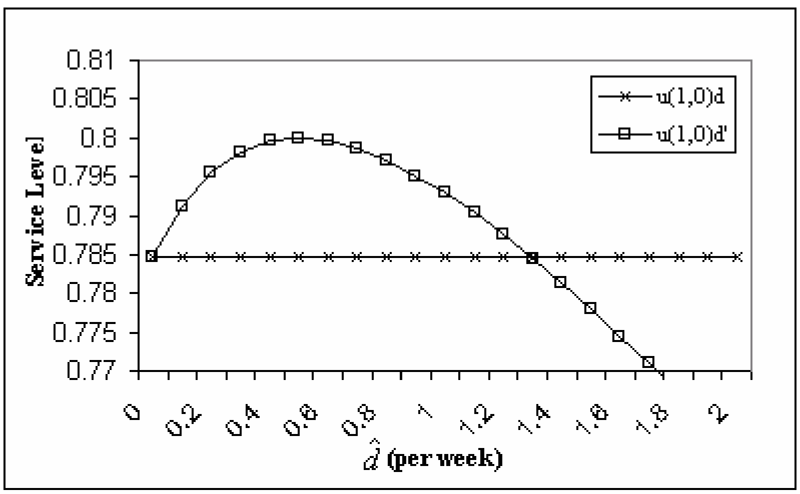



Figure 23. Increase in service with additional demand

### 1.4 **Numerical example**

Consider a single pool of two shared facilities. Suppose there exist a number of customers, 10 of which are potential dedicated facilities, and the rest are pooled together to form the demand vector $\mathbf{d} = [d_1 \quad d_2 \quad d_0 \quad d_{-1}]$ based on their locations. The system demand parameters and cost parameters are given in Table 18, and the demand for those customers with potential dedicated facilities can be seen in Table 19.

Suppose the customers with potential dedicated facilities are situated such that $J_1 = \{1,3,4,6,8,9,10\}$ are only within the time window of shared facility 1, $J_2 = \{2,7\}$ are only within the time window of shared facility 2, $J_0 = \{5\}$ is within the time window of both shared facilities, and $J_{-1} = \{\ \}$ are outside the time window of both shared facilities. For a system-wide target service level of $\alpha = 93\%$, the formulation in $\mathbf{P_{5'}}$ is solved using MOSEL as the modeling language and XpressMP as the solver. The optimal solution is to open and stock 1 unit in each shared facility, and open dedicated facilities at customer locations 6, 3, 9, and 4. This corresponds to a total cost of 11.61 units and a service level of 93.4%, and the problem is solved instantly (less than 1 second).

Among the customers with potential dedicated facilities, notice that the optimal solution chose to open dedicated facilities at those customer locations with high demand. In Section 2 of this chapter, we capitalize on this observation by incorporating it within a heuristic. However, when $\alpha = 92\%$, dedicated facilities 6, 3, and 1 are opened (i.e. locations 9 and 4 were skipped even though they had higher demand than location 1). Therefore, picking high demand customers as dedicated facilities remains sub-optimal.

Table 18. Input parameters for general case

| System Parameters | |
|---|---|
| $\bar{\lambda}$ | 1 |
| $\mu$ | 12 |
| $d_0$ | 0.25 |
| $d_1$ | 0.6 |
| $d_2$ | 0.1 |
| $d_{-1}$ | 0.05 |
| **Cost Parameters** | |
| $f$ | 2 |
| $\hat{f}$ | 1 |
| $h$ | 0.5 |
| $c^e$ | 1.5 |
| $c^{in}$ | 0.5 |
| $c^{out}$ | 0.75 |

Table 19. List of customers with potential dedicated facilities

| Potential Dedicated Facilities | |
|---|---|
| $j$ | $\hat{d}_j$ |
| 1 | 0.0656401 |
| 2 | 0.011916 |
| 3 | 0.0745505 |
| 4 | 0.0727971 |
| 5 | 0.0411361 |
| 6 | 0.0800164 |
| 7 | 0.0321793 |
| 8 | 0.0162623 |
| 9 | 0.073702 |
| 10 | 0.004096 |

## 2 Multiple pool inventory sharing problem with dedicated facilities

Let $J^p$ be the set of customers with potential dedicated facilities in pool $p$. An index $p$ is attached to all the variables and parameters indicating the pool they belong to. Recall the assumption that there is no region of overlap between pools, and customers cannot be assigned to facilities outside of their own pool. The multiple pool formulation is simply an extension of the single pool formulation ($\mathbf{P_{5''}}$) as shown below.

$\mathbf{P_{5''}}$**:**Minimize

$$\sum_{p\in P}\sum_{r\in R} z_{rp}(0,0)Y_{rp}(0,0)+z_{rp}(1,0)Y_{rp}(1,0)+z_{rp}(1,1)Y_{rp}(1,1) \qquad (4.1a'')$$

subject to

$$\sum_{p\in P} u_{rp}(0,0)Y_{rp}(0,0)+u_{rp}(1,0)Y_{rp}(1,0)+u_{rp}(1,1)Y_{rp}(1,1) \ge \alpha\sum_{p\in P}\left(\overline{\lambda}_p+\sum_{j\in J^p}\hat{d}_j\right) \qquad (4.1b'')$$

$$\sum_{r\in R} Y_{rp}(0,0)+Y_{rp}(1,0)+Y_{rp}(1,1)=1 \quad \forall p\in P \qquad (4.1j')$$

$$Y_{rp}(0,0),Y_{rp}(1,0),Y_{rp}(1,1)\in\{0,1\} \quad \forall r\in R, p\in P. \qquad (4.1k')$$

The main difference between $\mathbf{P_{5''}}$ and $\mathbf{P_{5'}}$ is that now constraint (4.1b′′) is the system-wide service level constraint which ties all the pools together. If each pool had its own target service level ($\alpha_p$ for example), then $\mathbf{P_{5''}}$ separates by pool and can be solved by solving $\mathbf{P_{5'}}$ for each pool.

Consider a network with parameter values as seen in Table 20. As we mentioned earlier, the above formulation ($\mathbf{P_{5''}}$) has a large number of variables because $|R| = 2^{|J^p|}$ for every pool *p*. Suppose all the pools have the same number of potential dedicated facilities $|J^p| = |J| \ \forall p\in P$. For a system-wide target service level of $\alpha = 75\%$, it is evident from Table 21 that the solution time increases exponentially with increase in $|J|$. To run the experiments in Table 21, we used a Pentium M 1.4GHz processor with 512 MB RAM.

Table 20. Parameters for solution time experiment

| System Parameters | |
|---|---|
| $\mu$ | 4 |
| $d_0$ | [0.05,0.1] |
| $d_1$ | [0.05,0.1] |
| $d_2$ | [0.05,0.1] |
| $d_{-1}$ | [0.01,0.02] |
| $\hat{d}_j$ | [0.005,0.01] |
| **Cost Parameters** | |
| $f$ | 10 |
| $\hat{f}$ | 1 |
| $h$ | 0.5 |
| $c^e$ | 1 |
| $c^{in}$ | 0.05 |
| $c^{out}$ | 0.075 |

Table 21. Solution time of multiple pool problem

| $\|P\|$ | $\|J\|$ | Opt sol time/s |
|---|---|---|
| 10 | 5 | 0.45 |
| 25 | 5 | 2.233 |
| 50 | 5 | 32.437 |
| 2 | 5 | 0.07 |
| 2 | 10 | 1.382 |
| 2 | 11 | 4.136 |
| 2 | 12 | 14.221 |
| 2 | 13 | 51.645 |

Due to this large number of combinations for open/close dedicated facility decisions, we derive a heuristic to obtain near-optimal solutions to the multiple pool problem. The heuristic is based on the special case algorithm in Section 1.3 and the observation in Section 1.4 that customers with high demand are likely to have dedicated facilities in the optimal solution.

The idea behind the heuristic is to first solve the multiple pool inventory sharing problem while ignoring all the potential dedicated facilities and their demand. This can be done using the greedy heuristic in Section 4 of Chapter 3. Next, we pick the potential dedicated facility with the highest demand and use the algorithm in Section 1.3 of this chapter to decide whether to open a dedicated facility at its location or not. Once all potential dedicated facilities in all the pools have been considered, if the solution is infeasible, then we simply upgrade pools and open dedicated facilities based on a cost/service ratio until the solution is feasible. Thus, we have an upper bound on the solution to problem $\mathbf{P_{5''}}$. In terms of lower bounds, computational results (in Section 3) show that the LP relaxation bound performs well for problem $\mathbf{P_{5''}}$.

We now define some new notation to help us with the heuristic. Let $z_p^*$ be the best objective value contribution of pool *p* at any given point in the heuristic and let $u_p^*$ be the corresponding contribution of pool *p* to the service level constraint. Suppose *k*, *l*, $m_p$, and $n_j$ are arbitrary parameters for bookkeeping purposes. Then, computational results (in Section 3) show that the following heuristic provides a good upper bound for problem $\mathbf{P_{5''}}$.

***Heuristic for the multiple pool, multiple dedicated facility problem***

***Step 1***. *Solve the multiple pool inventory sharing problem ignoring the demand of customers with potential dedicated facilities as follows.*

***Step 1.1***. *Initialize* $V_p = 0$, *and* $W_p = 0$ *for every pool* $p \in P$.

***Step 1.2***. *Sort all the pools in non-decreasing order of* $\dfrac{z_p(1,0)_{\mathbf{d}} - z_p(0,0)_{\mathbf{d}}}{u_p(1,0)_{\mathbf{d}} - u_p(0,0)_{\mathbf{d}}}$, *and set* $V_p = 1$ *in this order until either* $\sum_{p \in P}\left(u_p(1,0)_{\mathbf{d}} - u_p(0,0)_{\mathbf{d}}\right)V_p + \sum_{p \in P}\left(u_p(1,1)_{\mathbf{d}} - u_p(1,0)_{\mathbf{d}}\right)W_p \geq \alpha \sum_{p \in P} \overline{\lambda}_p$ *or* $V_p = 1, \forall p \in P$.

***Step 1.3***. *Sort all the pools in non-decreasing order of* $\frac{z_p(1,1)_{\mathbf{d}} - z_p(1,0)_{\mathbf{d}}}{u_p(1,1)_{\mathbf{d}} - u_p(1,0)_{\mathbf{d}}}$, *and set* $W_p = 1$ *in this order until either* $\sum_{p\in P}\left(u_p(1,0)_{\mathbf{d}} - u_p(0,0)_{\mathbf{d}}\right)V_p + \sum_{p\in P}\left(u_p(1,1)_{\mathbf{d}} - u_p(1,0)_{\mathbf{d}}\right)W_p \geq \alpha\sum_{p\in P}\overline{\lambda}_p$ *or* $W_p = 1, \forall p \in P$.

***Step 1.4***. *For every pool* $p \in P$, *if* $V_p = 1$, *then set* $z_p^* = z_p(1,0)_{\mathbf{d}}$ *and* $u_p^* = u_p(1,0)_{\mathbf{d}}$. *Otherwise, set* $z_p^* = z_p(0,0)_{\mathbf{d}}$ *and* $u_p^* = u_p(0,0)_{\mathbf{d}}$. *For every pool* $p \in P$, *if* $W_p = 1$, *then set* $z_p^* = z_p(1,1)_{\mathbf{d}}$ *and* $u_p^* = u_p(1,1)_{\mathbf{d}}$.

***Step 2***. *Consider each potential dedicated facility one at a time based on highest demand as shown below.*

***Step 2.1***. *Initialize* $\hat{Y}_j = 0 \ \forall j \in J^p, p \in P$.

***Step 2.2***. *Sort all the potential dedicated facilities in non-increasing order of* $\hat{d}_j$. *Among all pools* $p \in P$, *pick the potential dedicated facility* $\bar{j}$ *with the largest* $\hat{d}_j$ *and identify the pool* $\overline{p}$ *it belongs to. Add* $\hat{d}_{\bar{j}}$ *to the appropriate demand region to obtain* $\mathbf{d}'$, *and swap indices '1' and '2' if* $d_1 < d_2$ *in* $\mathbf{d}'$.

***Step 2.3***. *Evaluate the option of opening the dedicated facility (step 2.3.1) and the option of closing it (step 2.3.2).*

***Step 2.3.1.*** *If* $z_{\overline{p}}(1,1)_{\mathbf{d}} < z_{\overline{p}}(1,0)_{\mathbf{d}}$, *then go to step 2.3.1.1. Otherwise, if*

$$u(1,0)_{\overline{p}\mathbf{d}} + \hat{d}_{\bar{j}} + \sum_{p\in P\setminus\overline{p}} u_p^* < \alpha\left(\sum_{p\in P}\left(\overline{\lambda}_p + \sum_{j\in J^p}\hat{d}_j\hat{Y}_j\right) + \hat{d}_{\bar{j}}\right),$$ *then go to step 2.3.1.1.*

*Otherwise, go to step 2.3.1.2.*

***Step 2.3.1.1.*** *Set* $k = 2$, $\tilde{z}_{\overline{p}\mathbf{d}} = z_{\overline{p}}(1,1)_{\mathbf{d}} + \hat{f} + h + \sum_{j\in J^{\overline{p}}}\left(\hat{f} + h\right)\hat{Y}_j$, *and*

$$\tilde{u}_{\overline{p}\mathbf{d}} = u(1,1)_{\overline{p}\mathbf{d}} + \hat{d}_{\bar{j}} + \sum_{j\in J^{\overline{p}}}\hat{d}_j\hat{Y}_j.$$

***Step 2.3.1.2.*** *Set* $k = 1$, $\tilde{z}_{\bar{p}\mathbf{d}} = z_{\bar{p}}(1,0)_{\mathbf{d}} + \hat{f} + h + \sum_{j \in J^{\bar{p}}} (\hat{f} + h)\hat{Y}_j$, *and*

$\tilde{u}_{\bar{p}\mathbf{d}} = u(1,0)_{\bar{p}\mathbf{d}} + \hat{d}_{\bar{j}} + \sum_{j \in J^{\bar{p}}} \hat{d}_j \hat{Y}_j$.

***Step 2.3.2.*** *If* $z_{\bar{p}}(1,1)_{\mathbf{d}'} < z_{\bar{p}}(1,0)_{\mathbf{d}'}$, *then go to step 2.3.2.1. Otherwise, if*

$u(1,0)_{\bar{p}\mathbf{d}'} + \sum_{p \in P \setminus \bar{p}} u_p^* < \alpha \left( \sum_{p \in P} \left( \overline{\lambda}_p + \sum_{j \in J^p} \hat{d}_j \hat{Y}_j \right) + \hat{d}_{\bar{j}} \right)$, *then go to step 2.3.2.1. Otherwise, go to step 2.3.2.2.*

***Step 2.3.2.1.*** *Set* $l = 2$, $\tilde{z}_{\bar{p}\mathbf{d}'} = z_{\bar{p}}(1,1)_{\mathbf{d}'} + \sum_{j \in J^{\bar{p}}} (\hat{f} + h)\hat{Y}_j$, *and*

$\tilde{u}_{\bar{p}\mathbf{d}} = u(1,1)_{\bar{p}\mathbf{d}'} + \sum_{j \in J^{\bar{p}}} \hat{d}_j \hat{Y}_j$.

***Step 2.3.2.2.*** *Set* $l = 1$, $\tilde{z}_{\bar{p}\mathbf{d}'} = z_{\bar{p}}(1,0)_{\mathbf{d}'} + \sum_{j \in J^{\bar{p}}} (\hat{f} + h)\hat{Y}_j$, *and*

$\tilde{u}_{\bar{p}\mathbf{d}} = u(1,0)_{\bar{p}\mathbf{d}'} + \sum_{j \in J^{\bar{p}}} \hat{d}_j \hat{Y}_j$.

***Step 2.4***. *Compare alternatives as follows. If* $\tilde{z}_{\bar{p}\mathbf{d}'} < \tilde{z}_{\bar{p}\mathbf{d}}$ *and* $\tilde{u}_{\bar{p}\mathbf{d}'} + \sum_{p \in P \setminus \bar{p}} u_p^* \geq$ $\alpha \left( \sum_{p \in P} \left( \overline{\lambda}_p + \sum_{j \in J^p} \hat{d}_j \hat{Y}_j \right) + \hat{d}_{\bar{j}} \right)$ *then go to step 2.4.1. Otherwise, go to step 2.4.2.*

***Step 2.4.1.*** *Set* $\hat{Y}_{\bar{j}} = 0$, *and replace;* $z_{\bar{p}}^* \leftarrow \tilde{z}_{\bar{p}\mathbf{d}'}$, $u_{\bar{p}}^* \leftarrow \tilde{u}_{\bar{p}\mathbf{d}'}$, $\overline{\lambda}_p \leftarrow \overline{\lambda}_p + \hat{d}_{\bar{j}}$, *and* $\mathbf{d} \leftarrow \mathbf{d}'$. *If* $l = 2$, *then set* $W_{\bar{p}} = 1$ *and* $V_{\bar{p}} = 1$. *Otherwise, set* $V_{\bar{p}} = 1$.

***Step 2.4.2.*** *Set* $\hat{Y}_{\bar{j}} = 1$, *and replace;* $z_{\bar{p}}^* \leftarrow \tilde{z}_{\bar{p}\mathbf{d}}$, *and* $u_{\bar{p}}^* \leftarrow \tilde{u}_{\bar{p}\mathbf{d}}$. *If* $k = 2$, *then set* $W_{\bar{p}} = 1$ *and* $V_{\bar{p}} = 1$. *Otherwise, set* $V_{\bar{p}} = 1$.

***Step 3***. *If all the customers in pool* $\bar{p}$ *have been considered, then remove* $\bar{p}$ *from P. If* $|P| > 0$, *then go to step 2.2. Otherwise, if* $\sum_{p \in P} u_p^* \geq \alpha \sum_{p \in P} \left( \overline{\lambda}_p + \sum_{j \in J^p} \hat{d}_j \hat{Y}_j \right)$, *then report* $\hat{Y}_j \ \forall j \in J^p$, $V_p$, *and* $W_p \ \forall p \in P$. *Otherwise, go to step 4.*

***Step 4***. *Restore feasibility by upgrading pools and/or opening dedicated facilities as follows.*

***Step 4.1***. *For every pool* $p \in P$, *if* $V_p = 0$, *then set* $m_p = \dfrac{z_p(1,0)_{\mathbf{d}} - z_p(0,0)_{\mathbf{d}}}{u_p(1,0)_{\mathbf{d}} - u_p(0,0)_{\mathbf{d}}}$.

*Otherwise, if* $V_p = 1$ *and* $W_p = 0$, *then set* $m_p = \dfrac{z_p(1,1)_{\mathbf{d}} - z_p(1,0)_{\mathbf{d}}}{u_p(1,1)_{\mathbf{d}} - u_p(1,0)_{\mathbf{d}}}$. *Otherwise, set* $m_p = \infty$.

***Step 4.2***. *For every dedicated facility* $j \in J^p$ *in every pool* $p \in P$ *such that* $\hat{Y}_j = 0$, *if* $V_p = 0$ *then set* $n_j = \dfrac{z_p(0,0)_{\mathbf{d}} + \hat{f} + h - z_p(0,0)_{\mathbf{d}'}}{u_p(0,0)_{\mathbf{d}} + \hat{d}_j - u_p(0,0)_{\mathbf{d}'}}$. *Otherwise, if* $V_p = 1$ *and* $W_p = 0$, *then set* $n_j = \dfrac{z_p(1,0)_{\mathbf{d}} + \hat{f} + h - z_p(1,0)_{\mathbf{d}'}}{u_p(1,0)_{\mathbf{d}} + \hat{d}_j - u_p(1,0)_{\mathbf{d}'}}$. *Otherwise, set*

$$n_j = \frac{z_p(1,1)_{\mathbf{d}} + \hat{f} + h - z_p(1,1)_{\mathbf{d}}}{u_p(1,1)_{\mathbf{d}} + \hat{d}_j - u_p(1,1)_{\mathbf{d}}}.$$

***Step 4.3***. *Sort all* $m_p$ *and* $n_j$ *in non-decreasing order and upgrade pool p or open dedicated facility j in this order until* $\sum_{p \in P} \left(u_p(1,0)_{\mathbf{d}} - u_p(0,0)_{\mathbf{d}}\right)V_p + \left(u_p(1,1)_{\mathbf{d}} - u_p(1,0)_{\mathbf{d}}\right)W_p + \sum_{p \in P} \sum_{j \in J^p} \hat{d}_j \hat{Y}_j \geq \alpha \sum_{p \in P} \left( \overline{\lambda}_p + \sum_{j \in J^p} \hat{d}_j \right)$. *Report* $\hat{Y}_j$ $\forall j \in J^p$, $V_p$, *and* $W_p$ $\forall p \in P$.

In the next section, we see that this heuristic provides good upper bounds to problem $\mathbf{P_{5''}}$. However, this remains a heuristic because we do not revise stock level decisions at each step based on dedicated facility locations. We hope to address this issue in the future.

## 3 Computational results

In order to test the effects of the parameters on stock levels and dedicated facilities, we conduct experiments with varying parameter values for a network of $|P| = 10$ pools and each pool $p \in P$ having $\left|J^{p}\right| = 5$ dedicated facilities each. The formulation in **$P_{5''}$** is modeled in MOSEL using XpressMP as the solver. This is run on the same Pentium M 1.4 GHz processor with 512 MB RAM. We use the following combinations of parameter values.

- $f = \{10,20\}$
- $\hat{f} = \{1,2\}$
- $h = \{0.5,1.0\}$
- $c^{in} = \{0.05,0.1\}$
- $c^{out} = \{0.075,0.15\}$
- $c^{e} = \{1,2\}$
- $\alpha = \{0.70,0.75\}$
- $d_1 = \{[0,0.05],[0.05,0.1]\}$
- $d_2 = \{[0,0.05],[0.05,0.1]\}$
- $d_0 = \{[0,0.05],[0.05,0.1]\}$
- $d_{-1} = \{[0,0.01],[0.01,0.02]\}$
- $\hat{d} = \{[0,0.001],[0.001,0.002]\}$

As we mentioned earlier, the demand regions $d_1$, $d_2$, $d_0$, and $d_{-1}$ are random values in the given ranges, but we maintain the same set through all the experiments. The units of demand are in rates per week, and we set the replenishment rate as $\mu = 4$ per week. All cost parameters are in 1000s of $.

The results can be seen in Appendix I, and note that we only run those combinations where $c^{in} \le c^{out}$. The input parameters are organized as follows.

- Fixed cost of opening shared facilities – denoted by “ $f$ ”
- Fixed cost of opening dedicated facilities – denoted by “ $\hat{f}$ ”
- Holding cost per unit of inventory at each facility – denoted by “ $h$ ”

- Transportation cost of demand satisfied within the time window of a shared facility – denoted by "$c^{in}$"
- Transportation cost of demand satisfied outside the time window of a shared facility – denoted by "$c^{out}$"
- Transportation cost of demand satisfied as an emergency shipment from the central warehouse – denoted by "$c^{e}$"
- Target system wide service level – denoted by "$\alpha$"
- Total demand rate from customers only within the time window of shared facility 1 – denoted by "$d_1$"
- Total demand rate from customers only within the time window of shared facility 2 – denoted by "$d_2$"
- Total demand rate from customers that are within the time window of both shared facility 1 and shared facility 2 – denoted by "$d_0$"
- Total demand rate from customers that are not within the time window of any shared facility – denoted by "$d_{-1}$"
- Demand rate of customers with potential dedicated facilities – denoted by "$\hat{d}$"

The output is organized as follows.

- Optimization
    - Number of pools with $(S_{1p}, S_{2p}) = (0,0)$ – denoted by "Opt (0,0)"
    - Number of pools with $(S_{1p}, S_{2p}) = (1,0)$ – denoted by "Opt (1,0)"
    - Number of pools with $(S_{1p}, S_{2p}) = (1,1)$ – denoted by "Opt (1,1)"
    - Number of dedicated facilities opened – denoted by "Opt # ded"
    - Objective value – denoted by "Opt cost"
    - Service level – denoted by "Opt service"
    - Status of optimal solution at termination – denoted by "Opt status"
    - Time to obtain optimal solution – denoted by "Opt solTime"

- Heuristic
  - Number of pools with $(S_{1p}, S_{2p}) = (0,0)$ – denoted by "H (0,0)"
  - Number of pools with $(S_{1p}, S_{2p}) = (1,0)$ – denoted by "H (1,0)"
  - Number of pools with $(S_{1p}, S_{2p}) = (1,1)$ – denoted by "H (1,1)"
  - Number of dedicated facilities opened – denoted by "H # ded"
  - Objective value – denoted by "H cost"
  - Service level – denoted by "H service"
  - Time to obtain the heuristic's final solution – denoted by "H solTime"
- Gap between heuristic solution and optimal solution as a fraction of the optimal solution – denoted by "H-Opt gap"

The results show that the number of pools with two units of stock decreases with increase in $d_0$ (Table 22). This can be seen by comparing experiments 9-12 with experiments 13-16. Fewer units of inventory are sufficient because the degree of sharing is high. We observed similar results in Chapter 3 as well. In Table 22, the cost parameters are; $f = 10$, $\hat{f} = 1$, $h = 0.5$, $c^{in} = 0.05$, $c^{out} = 0.075$, $c^{e} = 1$, and $\alpha = 0.7$.

Table 22. Degree of sharing with respect to overlapping demand

| | Input Parameters | | | | Output | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $d_1,d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ | Opt (0,0) | Opt (1,0) | Opt (1,1) | Opt # ded | Opt cost | Opt service | Opt solTime |
| 9 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] | 0 | 7 | 3 | 0 | 136.6 | 0.7084 | 0.091 |
| 10 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] | 0 | 7 | 3 | 0 | 136.7 | 0.7088 | 0.1 |
| 11 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | 0.09 |
| 12 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] | 0 | 6 | 4 | 0 | 147.2 | 0.7105 | 0.11 |
| 13 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] | 0 | 8 | 2 | 0 | 126.2 | 0.7188 | 0.09 |
| 14 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] | 0 | 8 | 2 | 0 | 126.2 | 0.7182 | 0.1 |
| 15 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] | 0 | 7 | 3 | 0 | 136.7 | 0.7222 | 0.1 |
| 16 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] | 0 | 7 | 3 | 0 | 136.7 | 0.7218 | 0.141 |

Moreover, in Table 23 more dedicated facilities are opened when holding cost is low and demand is high. If we compare experiment 769 with 770, and experiment 771 with 772, we can see the effects of demand on the number of dedicated facilities. The effect of holding cost on the number of dedicated facilities can be seen by comparing experiment 770 with 962, and experiment 772 with 964. These results are consistent with our findings in Chapter 2. In Table 23, the cost parameters are; $f = 10$, $\hat{f} = 1$, $c^{in} = 0.05$, $c^{out} = 0.075$, and $c^{e} = 1$. Demand rates $d_1$,$d_2$ = [0,0.05], and $\alpha = 0.7$.

Table 23. Number of dedicated facilities with respect to holding cost and demand

| | Input Parameters | | | | Output | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $h$ | $d_0$ | $d_{-1}$ | $\hat{d}$ | Opt (0,0) | Opt (1,0) | Opt (1,1) | Opt # ded | Opt cost | Opt service | Opt solTime |
| 769 | 0.5 | [0,0.05] | [0,0.01] | [0,0.001] | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | 0.22 |
| 770 | 0.5 | [0,0.05] | [0,0.01] | [0.001,0.002] | 1 | 9 | 0 | 12 | 202.6 | 0.7004 | 0.3 |
| 771 | 0.5 | [0,0.05] | [0.01,0.02] | [0,0.001] | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | 0.201 |
| 772 | 0.5 | [0,0.05] | [0.01,0.02] | [0.001,0.002] | 0 | 9 | 1 | 13 | 245.1 | 0.7002 | 0.31 |
| 773 | 0.5 | [0.05,0.1] | [0,0.01] | [0,0.001] | 1 | 9 | 0 | 0 | 184.7 | 0.7276 | 0.2 |
| 774 | 0.5 | [0.05,0.1] | [0,0.01] | [0.001,0.002] | 1 | 9 | 0 | 0 | 184.7 | 0.7231 | 0.191 |
| 775 | 0.5 | [0.05,0.1] | [0.01,0.02] | [0,0.001] | 0 | 10 | 0 | 0 | 205.1 | 0.7378 | 0.21 |
| 776 | 0.5 | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] | 0 | 10 | 0 | 0 | 205.1 | 0.7358 | 0.2 |
| 961 | 1 | [0,0.05] | [0,0.01] | [0,0.001] | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | 0.231 |
| 962 | 1 | [0,0.05] | [0,0.01] | [0.001,0.002] | 0 | 10 | 0 | 0 | 210.1 | 0.714 | 0.28 |
| 963 | 1 | [0,0.05] | [0.01,0.02] | [0,0.001] | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | 0.231 |
| 964 | 1 | [0,0.05] | [0.01,0.02] | [0.001,0.002] | 0 | 8 | 2 | 0 | 252.1 | 0.7059 | 0.32 |
| 965 | 1 | [0.05,0.1] | [0,0.01] | [0,0.001] | 1 | 9 | 0 | 0 | 189.2 | 0.7276 | 0.23 |
| 966 | 1 | [0.05,0.1] | [0,0.01] | [0.001,0.002] | 1 | 9 | 0 | 0 | 189.2 | 0.7231 | 0.221 |
| 967 | 1 | [0.05,0.1] | [0.01,0.02] | [0,0.001] | 0 | 10 | 0 | 0 | 210.1 | 0.7378 | 0.22 |
| 968 | 1 | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] | 0 | 10 | 0 | 0 | 210.1 | 0.7358 | 0.23 |

***Performance of heuristic for multiple pool problem with dedicated facilities***

For this small size problem ($|P| = 10$ and $|J_p| = 5 \; \forall p \in P$), we see that the average gap between the heuristic solution and the optimal solution is 1.7%. On average, the heuristic takes less than 0.01 seconds to get within this range of the optimal solution. However, the main benefit of the heuristic is in dealing with larger size problems. In order to test the performance of the heuristic, we run the examples in Table 20 using the heuristic, the results of which can be seen in Table 24.

Table 24. Performance of the heuristic for larger problems

| $\lvert P \rvert$ | $\lvert J \rvert$ | Opt sol time/s | H sol time/s | LB sol time/s | H-LB gap | H-Opt gap |
|---|---|---|---|---|---|---|
| 10 | 5 | 0.45 | 0.01 | 0.04 | 0.013091 | 6.59E-06 |
| 25 | 5 | 2.233 | 0.02 | 0.09 | 0.019752 | 0.016099 |
| 50 | 5 | 32.437 | 0.06 | 0.19 | 0.021562 | 0.019756 |
| 2 | 5 | 0.07 | 0.01 | 0.03 | 0.007392 | 0 |
| 2 | 10 | 1.382 | 0.01 | 0.3 | 0.020847 | 2.03E-05 |
| 2 | 11 | 4.136 | 0.01 | 0.581 | 0.020301 | 0 |
| 2 | 12 | 14.221 | 0.01 | 1.202 | 0.009848 | 0 |
| 2 | 13 | 51.645 | 0.01 | 2.544 | 0.023617 | 0 |

In the above table, "H" stands for heuristic, and "LB" is the lower bound obtained from solving the LP relaxation of the optimization model. Notice that the heuristic provides an upper bound within 1.97% of the optimal almost instantly, and the maximum gap between the heuristic upper bound and the LP lower bound is 2.36%. Moreover, the heuristic seems to take longer as $\lvert P \rvert$ increases, but still shorter than the Xpress-MP solver used for optimization. A plot of the heuristic solution time versus optimization solution time with respect to $\lvert J \rvert$ is given in Figure 24.

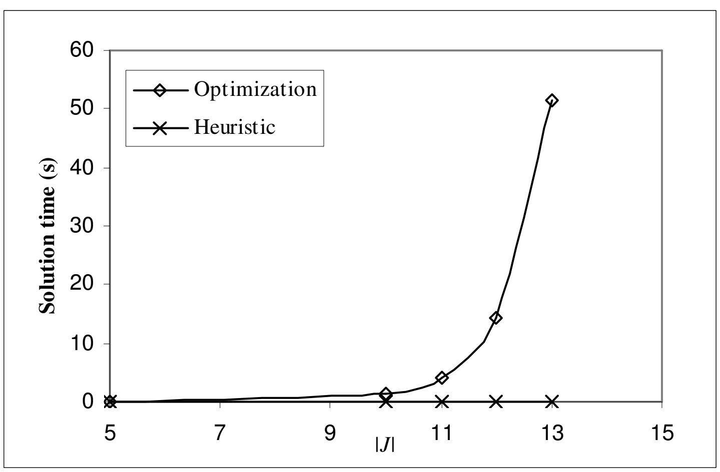



Figure 24. Solution time with respect to $\lvert J \rvert$

***Benefit of inventory sharing and dedicated facilities in NDIP***

Before concluding this chapter, we would like to compare the performance of the different models formulated in the literature as well as in this dissertation. The different models that we would like to compare are

1. Network design and inventory problem (Jeet (2006)),
2. Network design and inventory problem with dedicated facilities (Chapter 2),
3. Network design and inventory sharing problem (Chapter 3), and
4. Network design and inventory sharing problem with dedicated facilities (Chapter 4).

We now compare the performance of each of the above models for two different customer networks; a sparse distribution as seen in Figure 25, and a relatively denser distribution (Figure 26). The sparse network is generated by simply increasing the spacing between customers. Both networks consist of 8 facilities and 80 customers out of which 20 are potential dedicated facilities.

In terms of solution procedures, model (2) is solved using formulation $\mathbf{P_2}$ in Chapter 2, and model (1) is solved using the same formulation but the set of dedicated facilities $I'$=Ø is empty. When experimenting with models (3) and (4), we first group the customers and shared facilities into 4 pools such that each pool has 2 facilities. Then model (4) is solved using formulation $\mathbf{P_{5''}}$, and model (3) uses the same formulation with $J^p$=Ø $\forall p \in P$ .

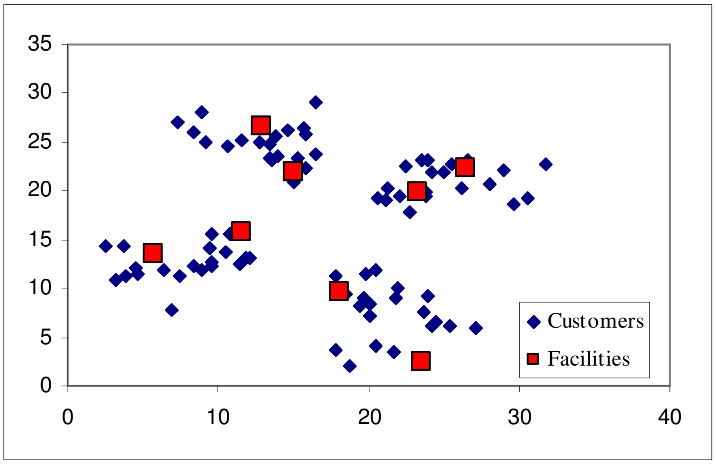



Figure 25. Sparse distribution of customers

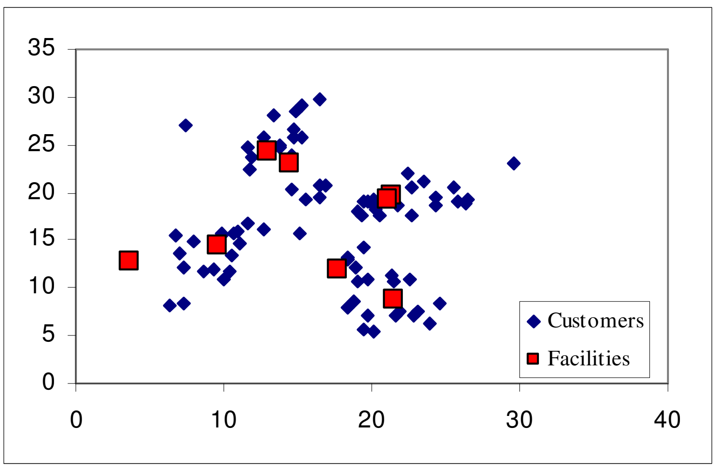



Figure 26. Dense distribution of customers

In order to perform a fair comparison of each of the models above, we set $c^e = 0$ in models (3) and (4). Moreover, in models (1) and (2), we replace $c_{i''j}$ with $c^{in} = 0.05$ if customer $j$ is within the time window of shared facility $i''$ and with $c^{out} = 0.075$ if not. By doing so, we can now compare the objective function values across models (1)-(4).

We run an experiment varying $f$, $\hat{f}$, $h$, and $\alpha$, as well as the mean demand rate of each customer. For the following ranges of parameter values

- $f = \{10,20\}$
- $\hat{f} = \{1,2\}$
- $h = \{0.5,1.0\}$
- $\alpha = \{0.70,0.75\}$
- $d_j = \{low, high\}$

where a "*low*" value for $d_j$ corresponds to demand rates in the range of $[0.0025,0.005]$ for customers with dedicated facilities and demand in the range of $[0.00025,0.0005]$ for the rest of the customers, and a "*high*" value of $d_j$ corresponds to demand rates ranging from $[0.005,0.01]$ for customers with dedicated facilities and $[0.0005,0.001]$ for the rest. Remember that these are all weekly demand rates, which is why the values are fairly small. The replenishment rate is $\mu = 4$ per week for these experiments.

The experimental results for the sparse network are given in Table 25, and Table 26 shows the results for the dense network. In each of the experiments, we are interested in the objective value and solution time of models (1)-(4). Note that all the models were run on a Pentium M 1.4 GHz processor with 512 MB of RAM.

Table 25. Model comparison results for sparse network

| Exp # | Input | | | | | Output | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $f$ | $\hat{f}$ | $h$ | $\alpha$ | $d_j$ | (1) NDIP | | (2) NDIP w/ded facs | | (3) Inv Sharing | | (4) Inv Sharing w/ded facs | |
| | | | | | | Obj | Time | Obj | Time | Obj | Time | Obj | Time |
| 1 | 10 | 1 | 0.5 | 0.6 | *low* | 43.505 | 20.349 | 21.003 | 2.814 | 52.504 | 0.07 | 16.5 | 0.141 |
| 2 | 10 | 1 | 0.5 | 0.7 | *low* | 63.004 | 9.784 | 24.002 | 3.385 | 63.004 | 0.06 | 19.5 | 0.1 |
| 3 | 10 | 1 | 1 | 0.6 | *low* | 47.005 | 26.638 | 25.003 | 0.741 | 55.004 | 0.06 | 22 | 0.13 |
| 4 | 10 | 1 | 1 | 0.7 | *low* | 66.004 | 8.683 | 29.002 | 4.757 | 66.004 | 0.06 | 26 | 0.09 |
| 5 | 10 | 2 | 0.5 | 0.6 | *low* | 43.505 | 19.758 | 28.003 | 2.273 | 52.504 | 0.05 | 27.5 | 0.13 |
| 6 | 10 | 2 | 0.5 | 0.7 | *low* | 63.004 | 9.804 | 33.002 | 3.285 | 63.004 | 0.06 | 32.5 | 0.09 |
| 7 | 10 | 2 | 1 | 0.6 | *low* | 47.005 | 26.749 | 32.003 | 3.215 | 55.004 | 0.06 | 32.001 | 0.211 |
| 8 | 10 | 2 | 1 | 0.7 | *low* | 66.004 | 8.662 | 38.002 | 4.787 | 66.004 | 0.06 | 38.001 | 0.15 |
| 9 | 20 | 1 | 0.5 | 0.6 | *low* | 83.505 | 14.131 | 31.003 | 2.704 | 102.5 | 0.06 | 16.5 | 0.12 |
| 10 | 20 | 1 | 0.5 | 0.7 | *low* | 123 | 11.186 | 34.002 | 3.354 | 123 | 0.06 | 19.5 | 0.09 |
| 11 | 20 | 1 | 1 | 0.6 | *low* | 87.005 | 27.9 | 35.003 | 0.741 | 105 | 0.051 | 22 | 0.13 |
| 12 | 20 | 1 | 1 | 0.7 | *low* | 126 | 9.934 | 39.002 | 4.196 | 126 | 0.05 | 26 | 0.091 |
| 13 | 20 | 2 | 0.5 | 0.6 | *low* | 83.505 | 14.12 | 38.003 | 2.724 | 102.5 | 0.06 | 27.5 | 0.12 |
| 14 | 20 | 2 | 0.5 | 0.7 | *low* | 123 | 11.216 | 43.002 | 3.625 | 123 | 0.06 | 32.5 | 0.09 |
| 15 | 20 | 2 | 1 | 0.6 | *low* | 87.005 | 28.08 | 42.003 | 2.774 | 105 | 0.06 | 33 | 0.13 |
| 16 | 20 | 2 | 1 | 0.7 | *low* | 126 | 9.954 | 48.002 | 3.375 | 126 | 0.06 | 39 | 0.1 |
| 17 | 10 | 1 | 0.5 | 0.6 | *high* | 52.509 | 28.891 | 21.006 | 2.343 | 52.509 | 0.06 | 16.5 | 0.17 |
| 18 | 10 | 1 | 0.5 | 0.7 | *high* | 63.009 | 5.378 | 24.005 | 5.368 | 63.009 | 0.051 | 19.5 | 0.1 |
| 19 | 10 | 1 | 1 | 0.6 | *high* | 55.009 | 50.613 | 25.006 | 2.283 | 55.009 | 0.07 | 22 | 0.13 |
| 20 | 10 | 1 | 1 | 0.7 | *high* | 66.009 | 8.983 | 29.005 | 3.785 | 66.009 | 0.06 | 26 | 0.1 |
| 21 | 10 | 2 | 0.5 | 0.6 | *high* | 52.509 | 27.93 | 28.006 | 1.823 | 52.509 | 0.05 | 27.5 | 0.131 |
| 22 | 10 | 2 | 0.5 | 0.7 | *high* | 63.009 | 5.358 | 33.005 | 4.667 | 63.009 | 0.05 | 32.5 | 0.11 |
| 23 | 10 | 2 | 1 | 0.6 | *high* | 55.009 | 50.873 | 32.006 | 5.708 | 55.009 | 0.06 | 32.001 | 0.34 |
| 24 | 10 | 2 | 1 | 0.7 | *high* | 66.009 | 8.983 | 38.005 | 4.386 | 66.009 | 0.06 | 38.001 | 0.17 |
| 25 | 20 | 1 | 0.5 | 0.6 | *high* | 102.51 | 18.907 | 31.006 | 2.254 | 102.51 | 0.06 | 16.5 | 0.121 |
| 26 | 20 | 1 | 0.5 | 0.7 | *high* | 123.01 | 8.893 | 34.005 | 5.307 | 123.01 | 0.05 | 19.5 | 0.1 |
| 27 | 20 | 1 | 1 | 0.6 | *high* | 105.01 | 33.568 | 35.006 | 2.273 | 105.01 | 0.05 | 22 | 0.15 |
| 28 | 20 | 1 | 1 | 0.7 | *high* | 126.01 | 5.448 | 39.005 | 4.015 | 126.01 | 0.05 | 26 | 0.11 |
| 29 | 20 | 2 | 0.5 | 0.6 | *high* | 102.51 | 20.029 | 38.006 | 6.229 | 102.51 | 0.05 | 27.5 | 0.13 |
| 30 | 20 | 2 | 0.5 | 0.7 | *high* | 123.01 | 9.033 | 43.005 | 4.186 | 123.01 | 0.05 | 32.5 | 0.111 |
| 31 | 20 | 2 | 1 | 0.6 | *high* | 105.01 | 32.817 | 42.006 | 2.274 | 105.01 | 0.05 | 33 | 0.13 |
| 32 | 20 | 2 | 1 | 0.7 | *high* | 126.01 | 5.127 | 48.005 | 3.565 | 126.01 | 0.06 | 39 | 0.1 |

Table 26. Model comparison results for dense network

| Exp # | Input | | | | | Output | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $f$ | $\hat{f}$ | $h$ | $\alpha$ | $d_j$ | (1) NDIP | | (2) NDIP w/ded facs | | (3) Inv Sharing | | (4) Inv Sharing w/ded facs | |
| | | | | | | Obj | Time | Obj | Time | Obj | Time | Obj | Time |
| 1 | 10 | 1 | 0.5 | 0.6 | *low* | 31.505 | 11.827 | 20.004 | 5.037 | 31.503 | 0.07 | 16.5 | 0.13 |
| 2 | 10 | 1 | 0.5 | 0.7 | *low* | 42.004 | 27.74 | 22.503 | 0.881 | 42.003 | 0.06 | 19.5 | 0.11 |
| 3 | 10 | 1 | 1 | 0.6 | *low* | 33.005 | 23.654 | 24.004 | 5.268 | 33.003 | 0.07 | 22 | 0.12 |
| 4 | 10 | 1 | 1 | 0.7 | *low* | 44.005 | 64.773 | 27.003 | 0.931 | 44.003 | 0.07 | 26 | 0.12 |
| 5 | 10 | 2 | 0.5 | 0.6 | *low* | 31.505 | 11.757 | 26.004 | 4.437 | 31.503 | 0.06 | 25.501 | 0.051 |
| 6 | 10 | 2 | 0.5 | 0.7 | *low* | 42.004 | 27.569 | 30.503 | 1.622 | 42.003 | 0.061 | 30.501 | 0.06 |
| 7 | 10 | 2 | 1 | 0.6 | *low* | 33.005 | 23.745 | 30.004 | 82.839 | 33.003 | 0.06 | 29.001 | 0.06 |
| 8 | 10 | 2 | 1 | 0.7 | *low* | 44.005 | 64.382 | 35.003 | 41.179 | 44.003 | 0.05 | 35.001 | 0.06 |
| 9 | 20 | 1 | 0.5 | 0.6 | *low* | 61.505 | 19.689 | 30.004 | 4.897 | 61.503 | 0.06 | 16.5 | 0.13 |
| 10 | 20 | 1 | 0.5 | 0.7 | *low* | 82.005 | 22.061 | 32.503 | 0.872 | 82.003 | 0.06 | 19.5 | 0.16 |
| 11 | 20 | 1 | 1 | 0.6 | *low* | 63.005 | 56.572 | 34.004 | 5.147 | 63.003 | 0.06 | 22 | 0.151 |
| 12 | 20 | 1 | 1 | 0.7 | *low* | 84.004 | 21.631 | 37.003 | 0.891 | 84.003 | 0.06 | 26 | 0.15 |
| 13 | 20 | 2 | 0.5 | 0.6 | *low* | 61.505 | 19.698 | 36.004 | 6.019 | 61.503 | 0.05 | 27.5 | 0.15 |
| 14 | 20 | 2 | 0.5 | 0.7 | *low* | 82.005 | 22.172 | 40.503 | 0.871 | 82.003 | 0.06 | 32.5 | 0.15 |
| 15 | 20 | 2 | 1 | 0.6 | *low* | 63.005 | 56.401 | 40.004 | 3.585 | 63.003 | 0.06 | 33 | 0.14 |
| 16 | 20 | 2 | 1 | 0.7 | *low* | 84.004 | 21.481 | 45.003 | 0.882 | 84.003 | 0.06 | 39 | 0.131 |
| 17 | 10 | 1 | 0.5 | 0.6 | *high* | 31.509 | 6.449 | 21.006 | 123.16 | 31.506 | 0.06 | 16.5 | 0.13 |
| 18 | 10 | 1 | 0.5 | 0.7 | *high* | 42.009 | 43.263 | 24.005 | 8.012 | 42.006 | 0.06 | 19.5 | 0.07 |
| 19 | 10 | 1 | 1 | 0.6 | *high* | 33.009 | 6.779 | 25.006 | 34.73 | 33.006 | 0.06 | 22 | 0.13 |
| 20 | 10 | 1 | 1 | 0.7 | *high* | 44.009 | 33.729 | 29.005 | 5.568 | 44.006 | 0.06 | 26 | 0.071 |
| 21 | 10 | 2 | 0.5 | 0.6 | *high* | 31.509 | 6.329 | 28.006 | 20.439 | 31.506 | 0.06 | 27.5 | 0.31 |
| 22 | 10 | 2 | 0.5 | 0.7 | *high* | 42.009 | 43.643 | 32.007 | 32.056 | 42.006 | 0.07 | 32.5 | 0.28 |
| 23 | 10 | 2 | 1 | 0.6 | *high* | 33.009 | 7.09 | 31.008 | 183.22 | 33.006 | 0.061 | 31.003 | 0.341 |
| 24 | 10 | 2 | 1 | 0.7 | *high* | 44.009 | 34.51 | 36.007 | 39.186 | 44.006 | 0.06 | 36.006 | 0.26 |
| 25 | 20 | 1 | 0.5 | 0.6 | *high* | 61.509 | 14.821 | 31.006 | 52.766 | 61.506 | 0.06 | 16.5 | 0.121 |
| 26 | 20 | 1 | 0.5 | 0.7 | *high* | 82.009 | 57.122 | 34.005 | 4.927 | 82.006 | 0.06 | 19.5 | 0.06 |
| 27 | 20 | 1 | 1 | 0.6 | *high* | 63.009 | 6.539 | 35.006 | 56.201 | 63.006 | 0.06 | 22 | 0.13 |
| 28 | 20 | 1 | 1 | 0.7 | *high* | 84.009 | 47.929 | 39.005 | 7.911 | 84.006 | 0.06 | 26 | 0.07 |
| 29 | 20 | 2 | 0.5 | 0.6 | *high* | 61.509 | 14.671 | 38.006 | 41.079 | 61.506 | 0.06 | 27.5 | 0.12 |
| 30 | 20 | 2 | 0.5 | 0.7 | *high* | 82.009 | 56.461 | 43.005 | 6.51 | 82.006 | 0.07 | 32.5 | 0.07 |
| 31 | 20 | 2 | 1 | 0.6 | *high* | 63.009 | 6.499 | 42.006 | 37.113 | 63.006 | 0.06 | 33 | 0.161 |
| 32 | 20 | 2 | 1 | 0.7 | *high* | 84.009 | 46.637 | 48.005 | 8.482 | 84.006 | 0.061 | 39 | 0.07 |

Across both sparse and dense networks, we see that model (2) always gives the same or better solutions than model (1) in less time. This supports the observation in Chapter 2 that adding dedicated facilities to the model can help with respect to solution time as well (although the model is in fact a generalization of the model without dedicated facilities). In Chapter 2, we also observed that more dedicated facilities are opened in sparse networks. A comparison of the reduction in the objective value from model (1) to model (2) in both networks supports this observation.

Similarly, compared to model (1), model (3) is always solved almost instantly. However, this solution is worse than that of model (1) when demand is low in the sparse network. Intuitively, this makes sense because demand in the overlapping region of both facilities is low, and hence the degree of sharing is reduced (which we also observed in Section 4 of Chapter 3).

Most importantly, a comparison of models (1) and (4) reflects the contribution of this dissertation. Compared to model (1), model (4) provides an average cost reduction of 63.8% in the sparse network and 46.5% in the dense network. Model (4) achieves this within 1% of the time taken by model (1). Figure 27 is a plot of the objective value versus solution time for each of the models in the dense network. The results of model (4) are clustered in the lower left corner of the plot. Therefore, the main contribution of this dissertation is that we provide a framework to solve a more realistic problem (NDIP with dedicated facilities and inventory sharing) such that we get a better solution in much less time.

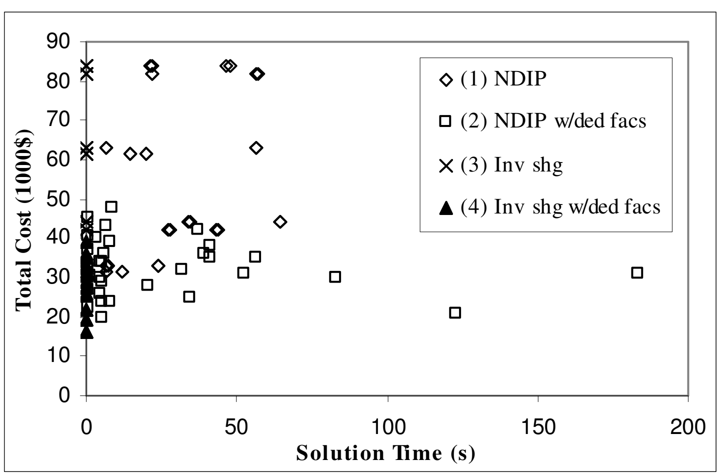



Figure 27. Solution quality and time of each model

Note that models (3) and (4) have certain restrictions; stock level at each facility can be at most 1 unit, and customers cannot be assigned to facilities outside of their pool. However, in a sparse network with low demand customers, the stock level required is low enough that the unit stock level restriction does not apply to models (1) and (2) anyway. Moreover, since the network is sparse, customers in models (1) and (2) are too far from the facilities in the other pools. Therefore, they are not assigned to facilities outside of their pool anyway. As a result, these restrictions do not hinder us from deriving conclusions from the experimental results.

## 4 Conclusions

In this chapter we formulate the network design and inventory problem with inventory sharing and dedicated facilities. Although the formulation is nonlinear, we provide an alternative formulation that has a binary knapsack structure. However, this formulation has a large number of variables.

In an attempt to find a better solution procedure, we first identified an algorithm to solve a special case problem (single pool with one potential dedicated facility). Then we constructed another heuristic for the multiple pool problem by combining the greedy heuristic for multiple pools (from Chapter 3) and extending the single pool algorithm (from this chapter). Using branch and bound (in XpressMP) to solve a problem with 2 pools and 13 dedicated facilities takes almost a minute, whereas the heuristic solves the same problem within 0.01 seconds.

While comparing the different formulations in this dissertation with respect to a given distribution of customers, we find that the multiple pool inventory sharing problem with dedicated facilities (from Chapter 4) provides an average cost reduction of 40-60% over the network design and inventory problem from the literature (Jeet (2006)). This reduction is obtained within 1% of the solution time. Experimental results also show that adding dedicated facilities to the solution procedure always helps with respect to the objective value and/or solution time, whereas inventory sharing may hurt with respect to the objective value especially in sparse networks with very low demand customers.

Another interesting non-intuitive result is that in some cases, additional demand to the system helps reduce cost and/or increase service. This is due to the assumption that each shared facility has to share inventory with the other shared facility in the pool.

# Chapter 5: Conclusions and Future Research

In this dissertation, we added two features to the existing network design and inventory optimization problem. We allow some customers to have dedicated facilities on-site, and we allow shared facilities to share inventory with one other facility. By taking advantage of the low demand nature of parts in SPL, we were able to formulate the problem with a binary knapsack structure.

Some of the major contributions of this dissertation are as follows.

- In the risk pooling problem, we discovered that the constraint was non-decreasing with respect to one of the variables. The non-linear integer problem could then be solved by simply evaluating a small set of undominated solutions. Moreover, we identify conditions where the optimal solution is complete centralization or complete decentralization. We also observe that the range of parameter values for which partial decentralization is optimal is very small.
- In the inventory sharing problem, we discovered that for given stock levels, demand allocation decisions are trivial. This is due to the dominance of certain variables over others with respect to the objective function and constraint coefficients. As a result, we were able to formulate the multiple pool sharing problem as a binary knapsack problem which can be solved easily.
- We formulated the combined problem of inventory sharing with customer dedicated facilities and constructed a heuristic that solves the problem in a short amount of time.

The main limitations of the model in Chapter 4 are that we assume small pool sizes of just two facilities each, and each facility being able to stock at most one unit of inventory. However, as a follow up to the work in this dissertation, we hope to generalize our results to cases with

- more than two potential shared facilities in a pool, and
- each shared facility being able to stock more than one unit of inventory.

In Chapter 4, we constructed a heuristic to obtain upper bounds, but we did not revise stock level decisions after making decisions on dedicated facilities. In the future, we would like to modify the heuristic so that we can obtain better upper bounds. As an alternative solution procedure, we would also like attempt to solve the multiple pool problem in Chapter 4 using branch and price since the problem has a large number of variables.

Furthermore, we would like to extend the formulation in Chapter 4 to include multiple parts with part commonality. The benefit of inventory sharing is further enhanced by part commonality. This could be achieved in combination with the work of Jeet (2006) in part commonality.

In the future, the model from Chapter 4 could be used in contract pricing for new customers. The additional demand could potentially improve service and/or reduce cost, as we have seen in Chapter 4.

# Appendices

### Appendix A – Linearized Formulation for NDIP (with sos2 variables)

Minimize $\sum_{i' \in I'} (f_{i'} + h_{i'}) Y_{i'} + \sum_{i'' \in I''} (f_{i''} Y_{i''} + h_{i''} S_{i''}) + \sum_{i'' \in I''} \sum_{j \in J} c_{i''j} d_j X_{i''j}$ (A-a)

Subject to $Y_{i'} + \sum_{i'' \in I''} X_{i''j} = 1 \quad \forall j \in I'$ (A-b)

$$\sum_{i'' \in I''} X_{i''j} = 1 \qquad \forall j \in J \setminus I' \qquad \text{(A-c)}$$

$$X_{i''j} \le Y_{i''} \qquad \forall i'' \in I'', j \in J \qquad \text{(A-d)}$$

$$\sum_{\substack{i' \in I', \\ j \in J \\ i' = j}} d_j Y_{i'} + \sum_{i'' \in I''} \sum_{j \in J_r} \delta_{i''j} d_j Z_{i''j} \ge \alpha_r \sum_{j \in J_r} d_j \qquad \forall r \in R \qquad \text{(A-e)}$$

$$S_{i''} \le s_{\max} Y_{i''} \qquad \forall i'' \in I'' \qquad \text{(A-f)}$$

$$\lambda_{i''} = t_{i''} \sum_{j \in J} d_j X_{i''j} \qquad \forall i'' \in I'' \qquad \text{(A-g)}$$

$$\lambda_{i''} \le \sum_{b \in B} db_b U_{i''b} \qquad \forall i'' \in I'' \qquad \text{(A-h)}$$

$$S_{i''} \ge \sum_{\bar{s} \in \bar{S}} \bar{s} V_{i''\bar{s}} \qquad \forall i'' \in I'' \qquad \text{(A-i)}$$

$$\beta_{i''} \le \sum_{b \in B} \sum_{\bar{s} \in \bar{S}} p_{b\bar{s}} w_{i''b\bar{s}} \qquad \forall i'' \in I'' \qquad \text{(A-j)}$$

$$\sum_{b \in B} U_{i''b} = 1 \qquad \forall i'' \in I'' \qquad \text{(A-k)}$$

$$\sum_{\bar{s} \in \bar{S}} V_{i''\bar{s}} = 1 \qquad \forall i'' \in I'' \qquad \text{(A-l)}$$

$$W_{i''b\bar{s}} \ge U_{i''b} + V_{i''\bar{s}} - 1 \qquad \forall i'' \in I'', b \in B, \bar{s} \in \bar{S} \qquad \text{(A-m1)}$$

$$W_{i''b\bar{s}} \le U_{i''b} - V_{i''\bar{s}} + 1 \qquad \forall i'' \in I'', b \in B, \bar{s} \in \bar{S} \qquad \text{(A-m2)}$$

$$W_{i''b\bar{s}} \le U_{i''b} \qquad \forall i'' \in I'', b \in B, \bar{s} \in \bar{S} \qquad \text{(A-m3)}$$

$$W_{i''b\bar{s}} \le V_{i''\bar{s}} \qquad \forall i'' \in I'', b \in B, \bar{s} \in \bar{S} \qquad \text{(A-m4)}$$

$$Z_{i''j} \ge \beta_{i''} + X_{i''j} - 1 \qquad \forall i'' \in I'', j \in J \qquad \text{(A-n1)}$$

$$Z_{i''j} \le \beta_{i''} - X_{i''j} + 1 \qquad \forall i'' \in I'', j \in J \qquad \text{(A-n2)}$$

$$Z_{i''j} \le \beta_{i''} \qquad \forall i'' \in I'', j \in J \qquad \text{(A-n3)}$$

$$Z_{i''j} \le X_{i''j} \qquad \forall i'' \in I'', j \in J \qquad \text{(A-n4)}$$

$$X_{i''j} \in \{0,1\} \qquad \forall i'' \in I'', j \in J \qquad \text{(A-o)}$$

$$Y_{i'} \in \{0,1\} \qquad \forall i' \in I' \qquad \text{(A-p)}$$

$$Y_{i''} \in \{0,1\} \qquad \forall i'' \in I'' \qquad \text{(A-q)}$$

$$S_{i''} \in \bar{S} \qquad \forall i'' \in I'' \qquad \text{(A-r)}$$

$$\lambda_{i''} \ge 0 \qquad \forall i'' \in I'' \qquad \text{(A-s)}$$

$$\beta_{i''} \ge 0 \qquad \forall i'' \in I'' \qquad \text{(A-t)}$$

$$0 \le U_{i''b} \le 1 \qquad \forall i'' \in I'', b \in B \qquad \text{(A-u)}$$

$$V_{i''\bar{s}} \in \{0,1\} \qquad \forall i'' \in I'', \bar{s} \in \bar{S} \qquad \text{(A-v)}$$

$$W_{i''b\bar{s}} \in \{0,1\} \qquad \forall i'' \in I'', b \in B, \bar{s} \in \bar{S} \qquad \text{(A-w)}$$

$$0 \le Z_{i''j} \le 1 \qquad \forall i'' \in I'', j \in J \qquad \text{(A-x)}$$

where $\bar{S} = \{0,1,2,...,s_{\max}\}$ is the set of feasible base stock levels,

$B$ is the set of demand break points,

$db_b$ is the demand at break point $b$,

$p_{b\bar{s}}$ is the fill rate when mean demand is $b$ and a base stock level is $\bar{s}$,

$V_{i''\bar{s}}$ is a binary variable set to 1 if shared facility $i''$ is stocked with $\bar{s}$ units,

$U_{i''b}$ is a sos2 variable used for interpolation,

$W_{i''b\bar{s}}$ is a temporary binary variable for linearization purposes, and

$Z_{i''j}$ is a temporary continuous variable for linearization purposes.

Constraints (A-a) through (A-g) have already been discussed in the NDIP nonlinear formulation. For each shared facility, constraint (A-h) assigns a mean demand value, constraint (A-i) assigns a base stock level, and constraint (A-j) assigns a fill rate.

Constraint (A-k) ensures that each shared facility is assigned a convex combination of two consecutive demand break points, and Constraint (A-l) ensures that every shared facility is assigned exactly one value as base stock level. For linearization purposes, constraints (A-m1) through (A-m4) set variable $W_{i''b\bar{s}}$ to the product of variables $U_{i''b}$ and $V_{i''\bar{s}}$. Similarly, constraints (A-n1) through (A-n4) set variable $Z_{i''j}$ to the product of variables $\beta_{i''}$ and $X_{i''j}$. The rest are non-negativity constraints.

Note that a sos2 variable is an ordered set of variables containing at most two non-zero elements, both of which have to be consecutive in their ordering. This enables us to easily interpolate between consecutive demand break points such that we obtain a convex combination of the two points.

## Appendix B – NDIP Formulation for Customer-Centric Service Levels and no dedicated facilities

Minimize $\sum_{i'\in I'}(f_{i'}+h_{i'})Y_{i'}+\sum_{i''\in I''}f_{i''}Y_{i''}+\sum_{i''\in I''}\sum_{j\in J}\sum_{g\in G_{i''}}c_{i''j}d_jX_{i''jg}+\sum_{i''\in I''}\sum_{g\in G_{i''}}\sum_{s\in S}sh_{i''}W_{i''gs}$ (B-a)

Subject to $Y_{i'}+\sum_{i''\in I''}\sum_{g\in G_{i''}:g\geq\alpha_j}X_{i''jg}=1 \qquad \forall j\in I'$ (B-b)

$$\sum_{i''\in I''}\sum_{g\in G_{i''}:g\geq\alpha_j}X_{i''jg}=1 \qquad \forall j\in J\setminus I' \tag{B-c}$$

$$Y_{i''}\geq\sum_{g\in G_{i''}}\sum_{s\in S}W_{i''gs} \qquad \forall i''\in I'' \tag{B-d}$$

$$M.\sum_{k=s+1}^{\hat{s}_{i''g}}W_{i''gn}\geq t_{i''}\sum_{j\in J_{i''}}d_jX_{i''jg}-b_{gs} \qquad \forall i''\in I'', g\in G_{i''}, s\in S \tag{B-e}$$

$$X_{i''jg}\in\{0,1\} \qquad \forall i''\in I'', j\in J, g\in G_{i''} \tag{B-f}$$

$$y_{i'}\in\{0,1\} \qquad \forall i'\in I' \tag{B-g}$$

$$y_{i''}\in\{0,1\} \qquad \forall i''\in I'' \tag{B-h}$$

$$w_{i''gs}\in\{0,1\} \qquad \forall i''\in I'', g\in G_{i''}, s\in S \tag{B-i}$$

where

$$J_{i''}=\{j\in J:\delta_{i''j}=1\}$$

$$I''_j=\{i''\in I'':\delta_{i''j}=1\}$$

$$G_{i''}=\{\alpha_j:j\in J_{i''}\}$$

$$1-\frac{\frac{b_{gs}{}^{s}}{s!}}{\sum_{k=0}^{s}\frac{b_{gs}{}^{k}}{k!}}=g \qquad \forall g\in G_{i''}, s\in S$$

$$1-\frac{\frac{b_{g\hat{s}_{i''g}}{}^{\hat{s}_{i''g}}}{\hat{s}_{i''g}!}}{\sum_{k=0}^{\hat{s}_{i''g}}\frac{b_{gk}{}^{k}}{k!}}=g \qquad \forall i''\in I'', g\in G_{i''}$$

In the above formulation, the binary assignment variable $X_{ijg}$ is 1 if customer $j$ is assigned to shared facility $i$ that has fill rate $g$, and 0 otherwise. The lead time demand corresponding to base stock level $s$ and fill rate $g$ is a parameter denoted by $b_{gs}$, and $\hat{s}_{ig}$ is another parameter that denotes the maximum potential inventory level at shared facility $i$ to guarantee fill rate $g$. A new stock picking binary variable $W_{igs}$ is also included in the model.

The updated objective function is seen as constraint (B-a). Constraints (B-b) and (B-c) are the combined assignment and service level constraints. Constraint (B-d) ensures that shared facilities are stocked only if they are opened, and constraint (B-e) assigns the stock picking variable appropriately. The rest are non-negativity constraints.

# Appendix C – DOE Results for a High Density Network

| | INPUT | | | | | | OUTPUT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp | $f_{i'}$ | $h_i$ | $\alpha_r$ | $d_j$ | % ded | % shd | # ded | # shd | s ded | s shd | Fixed Cost | Transp Cost | Inv Cost | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 1 | 0 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 7.411 | Opt | 45 | 0 |
| 2 | 0 | 0 | 0.6 | 0.005 | 50 | 100 | 25 | 9 | 25 | 45 | 0 | 1.15266 | 0 | 1.1527 | 7.14 | Opt | 54 | 0 |
| 3 | 0 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.181 | Opt | 1 | 0 |
| 4 | 0 | 0 | 0.6 | 0.005 | 100 | 100 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.26 | Opt | 1 | 0 |
| 5 | 0 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 4.83466 | 0 | 4.8347 | 8.652 | Opt | 102 | 0 |
| 6 | 0 | 0 | 0.6 | 0.01 | 50 | 100 | 25 | 9 | 25 | 45 | 0 | 2.30531 | 0 | 2.3053 | 6.86 | Opt | 55 | 0 |
| 7 | 0 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.181 | Opt | 1 | 0 |
| 8 | 0 | 0 | 0.6 | 0.01 | 100 | 100 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.25 | Opt | 1 | 0 |
| 9 | 0 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 8.082 | Opt | 156 | 0 |
| 10 | 0 | 0 | 0.8 | 0.005 | 50 | 100 | 25 | 9 | 25 | 45 | 0 | 1.15266 | 0 | 1.1527 | 8.191 | Opt | 62 | 0 |
| 11 | 0 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.191 | Opt | 1 | 0 |
| 12 | 0 | 0 | 0.8 | 0.005 | 100 | 100 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.26 | Opt | 1 | 0 |
| 13 | 0 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 4.83466 | 0 | 4.8347 | 8.693 | Opt | 154 | 0 |
| 14 | 0 | 0 | 0.8 | 0.01 | 50 | 100 | 25 | 9 | 25 | 45 | 0 | 2.30531 | 0 | 2.3053 | 9.463 | Opt | 313 | 0 |
| 15 | 0 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.181 | Opt | 1 | 0 |
| 16 | 0 | 0 | 0.8 | 0.01 | 100 | 100 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.27 | Opt | 1 | 0 |
| 17 | 0 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 7.841 | Opt | 128 | 0 |
| 18 | 0 | 0.1 | 0.6 | 0.005 | 50 | 100 | 2 | 8 | 2 | 8 | 0 | 2.1507 | 1 | 3.1507 | 11.557 | Opt | 145 | 0 |
| 19 | 0 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.19 | Opt | 1 | 0 |
| 20 | 0 | 0.1 | 0.6 | 0.005 | 100 | 100 | 4 | 8 | 4 | 8 | 0 | 1.93606 | 1.2 | 3.1361 | 6.109 | Opt | 38 | 0 |
| 21 | 0 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 8.062 | Opt | 72 | 0 |
| 22 | 0 | 0.1 | 0.6 | 0.01 | 50 | 100 | 11 | 8 | 11 | 8 | 0 | 3.08283 | 1.9 | 4.9828 | 8.161 | Opt | 37 | 0 |
| 23 | 0 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.201 | Opt | 1 | 0 |
| 24 | 0 | 0.1 | 0.6 | 0.01 | 100 | 100 | 30 | 4 | 30 | 4 | 0 | 0.8982 | 3.4 | 4.2982 | 3.705 | Opt | 22 | 0 |
| 25 | 0 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 6.129 | Opt | 37 | 0 |
| 26 | 0 | 0.1 | 0.8 | 0.005 | 50 | 100 | 2 | 8 | 2 | 8 | 0 | 2.1507 | 1 | 3.1507 | 5.307 | Opt | 21 | 0 |
| 27 | 0 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.21 | Opt | 1 | 0 |
| 28 | 0 | 0.1 | 0.8 | 0.005 | 100 | 100 | 4 | 8 | 4 | 8 | 0 | 1.93606 | 1.2 | 3.1361 | 8.202 | Opt | 36 | 0 |
| 29 | 0 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 8.492 | Opt | 63 | 0 |
| 30 | 0 | 0.1 | 0.8 | 0.01 | 50 | 100 | 11 | 8 | 11 | 8 | 0 | 3.08283 | 1.9 | 4.9828 | 11.386 | Opt | 123 | 0 |
| 31 | 0 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.211 | Opt | 1 | 0 |
| 32 | 0 | 0.1 | 0.8 | 0.01 | 100 | 100 | 30 | 4 | 30 | 4 | 0 | 0.8982 | 3.4 | 4.2982 | 4.015 | Opt | 17 | 0 |
| 33 | 0 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 5.448 | Opt | 26 | 0 |
| 34 | 0 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 7.451 | Opt | 93 | 0 |
| 35 | 0 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.21 | Opt | 1 | 0 |
| 36 | 0 | 0.2 | 0.6 | 0.005 | 100 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 8.232 | Opt | 64 | 0 |
| 37 | 0 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 7.861 | Opt | 36 | 0 |
| 38 | 0 | 0.2 | 0.6 | 0.01 | 50 | 100 | 2 | 8 | 2 | 8 | 0 | 4.3014 | 2 | 6.3014 | 8.423 | Opt | 71 | 0 |
| 39 | 0 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.21 | Opt | 1 | 0 |
| 40 | 0 | 0.2 | 0.6 | 0.01 | 100 | 100 | 4 | 8 | 4 | 8 | 0 | 3.87212 | 2.4 | 6.2721 | 8.622 | Opt | 75 | 0 |
| 41 | 0 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 7.371 | Opt | 51 | 0 |
| 42 | 0 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 6.099 | Opt | 17 | 0 |
| 43 | 0 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.21 | Opt | 1 | 0 |
| 44 | 0 | 0.2 | 0.8 | 0.005 | 100 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 9.694 | Opt | 104 | 0 |
| 45 | 0 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 9.123 | Opt | 75 | 0 |
| 46 | 0 | 0.2 | 0.8 | 0.01 | 50 | 100 | 2 | 8 | 2 | 8 | 0 | 4.3014 | 2 | 6.3014 | 7.972 | Opt | 26 | 0 |
| 47 | 0 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.22 | Opt | 1 | 0 |
| 48 | 0 | 0.2 | 0.8 | 0.01 | 100 | 100 | 4 | 8 | 4 | 8 | 0 | 3.87212 | 2.4 | 6.2721 | 9.063 | Opt | 71 | 0 |

| Exp | INPUT | | | | | | OUTPUT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $f_{i'}$ | $h_i$ | $\alpha_r$ | $d_j$ | % ded | % shd | # ded | # shd | s ded | s shd | Fixed Cost | Transp Cost | Inv Cost | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 49 | 0.2 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 7.361 | Opt | 45 | 0 |
| 50 | 0.2 | 0 | 0.6 | 0.005 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 6.729 | Opt | 13 | 0 |
| 51 | 0.2 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.221 | Opt | 1 | 0 |
| 52 | 0.2 | 0 | 0.6 | 0.005 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 8.532 | Opt | 181 | 0 |
| 53 | 0.2 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 4.83466 | 0 | 4.8347 | 8.943 | Opt | 102 | 0 |
| 54 | 0.2 | 0 | 0.6 | 0.01 | 50 | 100 | 2 | 10 | 2 | 50 | 0.4 | 4.24274 | 0 | 4.6427 | 7.391 | Opt | 34 | 0 |
| 55 | 0.2 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.22 | Opt | 1 | 0 |
| 56 | 0.2 | 0 | 0.6 | 0.01 | 100 | 100 | 4 | 10 | 4 | 50 | 0.8 | 3.81347 | 0 | 4.6135 | 24.876 | Opt | 636 | 0 |
| 57 | 0.2 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 8.492 | Opt | 156 | 0 |
| 58 | 0.2 | 0 | 0.8 | 0.005 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 8.773 | Opt | 185 | 0 |
| 59 | 0.2 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.22 | Opt | 1 | 0 |
| 60 | 0.2 | 0 | 0.8 | 0.005 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 12.668 | Opt | 189 | 0 |
| 61 | 0.2 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 4.83466 | 0 | 4.8347 | 9.013 | Opt | 154 | 0 |
| 62 | 0.2 | 0 | 0.8 | 0.01 | 50 | 100 | 2 | 10 | 2 | 50 | 0.4 | 4.24274 | 0 | 4.6427 | 8.162 | Opt | 24 | 0 |
| 63 | 0.2 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.23 | Opt | 1 | 0 |
| 64 | 0.2 | 0 | 0.8 | 0.01 | 100 | 100 | 4 | 10 | 4 | 50 | 0.8 | 3.81347 | 0 | 4.6135 | 8.813 | Opt | 98 | 0 |
| 65 | 0.2 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 8.242 | Opt | 128 | 0 |
| 66 | 0.2 | 0.1 | 0.6 | 0.005 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 5.898 | Opt | 21 | 0 |
| 67 | 0.2 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.231 | Opt | 1 | 0 |
| 68 | 0.2 | 0.1 | 0.6 | 0.005 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 6.759 | Opt | 21 | 0 |
| 69 | 0.2 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 8.362 | Opt | 72 | 0 |
| 70 | 0.2 | 0.1 | 0.6 | 0.01 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 10.556 | Opt | 83 | 0 |
| 71 | 0.2 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.23 | Opt | 1 | 0 |
| 72 | 0.2 | 0.1 | 0.6 | 0.01 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 7.561 | Opt | 118 | 0 |
| 73 | 0.2 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 6.459 | Opt | 37 | 0 |
| 74 | 0.2 | 0.1 | 0.8 | 0.005 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 7.12 | Opt | 25 | 0 |
| 75 | 0.2 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.231 | Opt | 1 | 0 |
| 76 | 0.2 | 0.1 | 0.8 | 0.005 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 9.023 | Opt | 51 | 0 |
| 77 | 0.2 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 8.782 | Opt | 63 | 0 |
| 78 | 0.2 | 0.1 | 0.8 | 0.01 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 17.235 | Opt | 149 | 0 |
| 79 | 0.2 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.241 | Opt | 1 | 0 |
| 80 | 0.2 | 0.1 | 0.8 | 0.01 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 7.26 | Opt | 20 | 0 |
| 81 | 0.2 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 5.608 | Opt | 26 | 0 |
| 82 | 0.2 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 12.178 | Opt | 241 | 0 |
| 83 | 0.2 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.24 | Opt | 1 | 0 |
| 84 | 0.2 | 0.2 | 0.6 | 0.005 | 100 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 5.448 | Opt | 19 | 0 |
| 85 | 0.2 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 8.122 | Opt | 36 | 0 |
| 86 | 0.2 | 0.2 | 0.6 | 0.01 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 6.309 | Opt | 28 | 0 |
| 87 | 0.2 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.25 | Opt | 1 | 0 |
| 88 | 0.2 | 0.2 | 0.6 | 0.01 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 10.716 | Opt | 77 | 0 |
| 89 | 0.2 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 7.651 | Opt | 51 | 0 |
| 90 | 0.2 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 8.472 | Opt | 40 | 0 |
| 91 | 0.2 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.24 | Opt | 1 | 0 |
| 92 | 0.2 | 0.2 | 0.8 | 0.005 | 100 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 9.374 | Opt | 43 | 0 |
| 93 | 0.2 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 9.644 | Opt | 75 | 0 |
| 94 | 0.2 | 0.2 | 0.8 | 0.01 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 6.068 | Opt | 33 | 0 |
| 95 | 0.2 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.251 | Opt | 1 | 0 |
| 96 | 0.2 | 0.2 | 0.8 | 0.01 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 4.386 | Opt | 1 | 0 |

| | INPUT | | | | | | OUTPUT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp | $f_{i'}$ | $h_i$ | $\alpha_r$ | $d_j$ | % ded | % shd | # ded | # shd | s ded | s shd | Fixed Cost | Transp Cost | Inv Cost | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 97 | 0.4 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 7.861 | Opt | 45 | 0 |
| 98 | 0.4 | 0 | 0.6 | 0.005 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 6.46 | Opt | 13 | 0 |
| 99 | 0.4 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.26 | Opt | 1 | 0 |
| 100 | 0.4 | 0 | 0.6 | 0.005 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 10.525 | Opt | 312 | 0 |
| 101 | 0.4 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 4.83466 | 0 | 4.8347 | 9.464 | Opt | 102 | 0 |
| 102 | 0.4 | 0 | 0.6 | 0.01 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 4.83466 | 0 | 4.8347 | 7.951 | Opt | 30 | 0 |
| 103 | 0.4 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.251 | Opt | 1 | 0 |
| 104 | 0.4 | 0 | 0.6 | 0.01 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 4.83466 | 0 | 4.8347 | 8.061 | Opt | 38 | 0 |
| 105 | 0.4 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 9.063 | Opt | 156 | 0 |
| 106 | 0.4 | 0 | 0.8 | 0.005 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 8.883 | Opt | 174 | 0 |
| 107 | 0.4 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.261 | Opt | 1 | 0 |
| 108 | 0.4 | 0 | 0.8 | 0.005 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 2.41733 | 0 | 2.4173 | 9.874 | Opt | 59 | 0 |
| 109 | 0.4 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 4.83466 | 0 | 4.8347 | 9.453 | Opt | 154 | 0 |
| 110 | 0.4 | 0 | 0.8 | 0.01 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 4.83466 | 0 | 4.8347 | 32.337 | Opt | 841 | 0 |
| 111 | 0.4 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.26 | Opt | 1 | 0 |
| 112 | 0.4 | 0 | 0.8 | 0.01 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 4.83466 | 0 | 4.8347 | 8.863 | Opt | 53 | 0 |
| 113 | 0.4 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 8.572 | Opt | 128 | 0 |
| 114 | 0.4 | 0.1 | 0.6 | 0.005 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 6.159 | Opt | 21 | 0 |
| 115 | 0.4 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.271 | Opt | 1 | 0 |
| 116 | 0.4 | 0.1 | 0.6 | 0.005 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 6.97 | Opt | 21 | 0 |
| 117 | 0.4 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 8.712 | Opt | 72 | 0 |
| 118 | 0.4 | 0.1 | 0.6 | 0.01 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 11.026 | Opt | 83 | 0 |
| 119 | 0.4 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.271 | Opt | 1 | 0 |
| 120 | 0.4 | 0.1 | 0.6 | 0.01 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 7.991 | Opt | 40 | 0 |
| 121 | 0.4 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 6.59 | Opt | 37 | 0 |
| 122 | 0.4 | 0.1 | 0.8 | 0.005 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 7.28 | Opt | 25 | 0 |
| 123 | 0.4 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.27 | Opt | 1 | 0 |
| 124 | 0.4 | 0.1 | 0.8 | 0.005 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 2.44666 | 0.8 | 3.2467 | 9.374 | Opt | 51 | 0 |
| 125 | 0.4 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 9.033 | Opt | 63 | 0 |
| 126 | 0.4 | 0.1 | 0.8 | 0.01 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 17.055 | Opt | 141 | 0 |
| 127 | 0.4 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.28 | Opt | 1 | 0 |
| 128 | 0.4 | 0.1 | 0.8 | 0.01 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 0.8 | 5.6933 | 12.898 | Opt | 103 | 0 |
| 129 | 0.4 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 5.789 | Opt | 26 | 0 |
| 130 | 0.4 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 15.132 | Opt | 324 | 0 |
| 131 | 0.4 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.29 | Opt | 1 | 0 |
| 132 | 0.4 | 0.2 | 0.6 | 0.005 | 100 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 5.668 | Opt | 19 | 0 |
| 133 | 0.4 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 8.372 | Opt | 36 | 0 |
| 134 | 0.4 | 0.2 | 0.6 | 0.01 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 6.63 | Opt | 28 | 0 |
| 135 | 0.4 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.3 | Opt | 1 | 0 |
| 136 | 0.4 | 0.2 | 0.6 | 0.01 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 8.683 | Opt | 91 | 0 |
| 137 | 0.4 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 7.971 | Opt | 51 | 0 |
| 138 | 0.4 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 8.763 | Opt | 40 | 0 |
| 139 | 0.4 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.28 | Opt | 1 | 0 |
| 140 | 0.4 | 0.2 | 0.8 | 0.005 | 100 | 100 | 0 | 6 | 0 | 6 | 0 | 2.70759 | 1.2 | 3.9076 | 9.604 | Opt | 43 | 0 |
| 141 | 0.4 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 9.984 | Opt | 75 | 0 |
| 142 | 0.4 | 0.2 | 0.8 | 0.01 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 7.951 | Opt | 39 | 0 |
| 143 | 0.4 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.29 | Opt | 1 | 0 |
| 144 | 0.4 | 0.2 | 0.8 | 0.01 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 4.89332 | 1.6 | 6.4933 | 8.072 | Opt | 41 | 0 |

# Appendix D – DOE Results for System-Wide Service Level Scenario

| | INPUT | | | | | | OUTPUT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp | $f_{i'}$ | $h_i$ | $\alpha_r$ | $d_j$ | % ded | % shd | # ded | # shd | s ded | s shd | Fixed Cost | Transp Cost | Inv Cost | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 1 | 0 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 9.624 | Opt | 125 | 0 |
| 2 | 0 | 0 | 0.6 | 0.005 | 50 | 100 | 25 | 9 | 25 | 45 | 0 | 1.73119 | 0 | 1.7312 | 3.205 | Opt | 11 | 0 |
| 3 | 0 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.19 | Opt | 1 | 0 |
| 4 | 0 | 0 | 0.6 | 0.005 | 100 | 100 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.26 | Opt | 1 | 0 |
| 5 | 0 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 6.54961 | 0 | 6.5496 | 7.191 | Opt | 56 | 0 |
| 6 | 0 | 0 | 0.6 | 0.01 | 50 | 100 | 25 | 9 | 25 | 45 | 0 | 3.46237 | 0 | 3.4624 | 2.583 | Opt | 11 | 0 |
| 7 | 0 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.181 | Opt | 1 | 0 |
| 8 | 0 | 0 | 0.6 | 0.01 | 100 | 100 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.27 | Opt | 1 | 0 |
| 9 | 0 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 8.973 | Opt | 50 | 0 |
| 10 | 0 | 0 | 0.8 | 0.005 | 50 | 100 | 25 | 9 | 25 | 45 | 0 | 1.73119 | 0 | 1.7312 | 5.778 | Opt | 18 | 0 |
| 11 | 0 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.191 | Opt | 1 | 0 |
| 12 | 0 | 0 | 0.8 | 0.005 | 100 | 100 | 50 | 1 | 50 | 5 | 0 | 0 | 0 | 0 | 0.821 | Opt | 1 | 0 |
| 13 | 0 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 6.54961 | 0 | 6.5496 | 7.521 | Opt | 32 | 0 |
| 14 | 0 | 0 | 0.8 | 0.01 | 50 | 100 | 25 | 9 | 25 | 45 | 0 | 3.46237 | 0 | 3.4624 | 4.086 | Opt | 3 | 0 |
| 15 | 0 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.19 | Opt | 1 | 0 |
| 16 | 0 | 0 | 0.8 | 0.01 | 100 | 100 | 50 | 1 | 50 | 5 | 0 | 0 | 0 | 0 | 0.831 | Opt | 1 | 0 |
| 17 | 0 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 4.517 | Opt | 28 | 0 |
| 18 | 0 | 0.1 | 0.6 | 0.005 | 50 | 100 | 4 | 7 | 4 | 7 | 0 | 2.85746 | 1.1 | 3.9575 | 10.094 | Opt | 157 | 0 |
| 19 | 0 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.19 | Opt | 1 | 0 |
| 20 | 0 | 0.1 | 0.6 | 0.005 | 100 | 100 | 11 | 7 | 11 | 7 | 0 | 1.86172 | 1.8 | 3.6617 | 5.629 | Opt | 103 | 0 |
| 21 | 0 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 6.64784 | 0.8 | 7.4478 | 6.038 | Opt | 44 | 0 |
| 22 | 0 | 0.1 | 0.6 | 0.01 | 50 | 100 | 14 | 8 | 14 | 8 | 0 | 4.24476 | 2.2 | 6.4448 | 4.997 | Opt | 9 | 0 |
| 23 | 0 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.201 | Opt | 1 | 0 |
| 24 | 0 | 0.1 | 0.6 | 0.01 | 100 | 100 | 31 | 4 | 31 | 4 | 0 | 1.22778 | 3.5 | 4.7278 | 1.091 | Opt | 1 | 0 |
| 25 | 0 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 6.69 | Opt | 49 | 0 |
| 26 | 0 | 0.1 | 0.8 | 0.005 | 50 | 100 | 4 | 7 | 4 | 7 | 0 | 2.85746 | 1.1 | 3.9575 | 9.123 | Opt | 41 | 0 |
| 27 | 0 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.2 | Opt | 1 | 0 |
| 28 | 0 | 0.1 | 0.8 | 0.005 | 100 | 100 | 11 | 7 | 11 | 7 | 0 | 1.86172 | 1.8 | 3.6617 | 6.43 | Opt | 67 | 0 |
| 29 | 0 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 6.64784 | 0.8 | 7.4478 | 10.725 | Opt | 153 | 0 |
| 30 | 0 | 0.1 | 0.8 | 0.01 | 50 | 100 | 14 | 8 | 14 | 8 | 0 | 4.24476 | 2.2 | 6.4448 | 4.316 | Opt | 6 | 0 |
| 31 | 0 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.201 | Opt | 1 | 0 |
| 32 | 0 | 0.1 | 0.8 | 0.01 | 100 | 100 | 31 | 4 | 31 | 4 | 0 | 1.22778 | 3.5 | 4.7278 | 3.675 | Opt | 3 | 0 |
| 33 | 0 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 10.545 | Opt | 149 | 0 |
| 34 | 0 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 6.099 | Opt | 54 | 0 |
| 35 | 0 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.21 | Opt | 1 | 0 |
| 36 | 0 | 0.2 | 0.6 | 0.005 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 5.228 | Opt | 10 | 0 |
| 37 | 0 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 4.987 | Opt | 18 | 0 |
| 38 | 0 | 0.2 | 0.6 | 0.01 | 50 | 100 | 4 | 7 | 4 | 7 | 0 | 5.71491 | 2.2 | 7.9149 | 5.628 | Opt | 25 | 0 |
| 39 | 0 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.2 | Opt | 1 | 0 |
| 40 | 0 | 0.2 | 0.6 | 0.01 | 100 | 100 | 11 | 7 | 11 | 7 | 0 | 3.72344 | 3.6 | 7.3234 | 9.965 | Opt | 97 | 0 |
| 41 | 0 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 6.9 | Opt | 29 | 0 |
| 42 | 0 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 16.964 | Opt | 269 | 0 |
| 43 | 0 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.22 | Opt | 1 | 0 |
| 44 | 0 | 0.2 | 0.8 | 0.005 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 8.573 | Opt | 73 | 0 |
| 45 | 0 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 7.851 | Opt | 85 | 0 |
| 46 | 0 | 0.2 | 0.8 | 0.01 | 50 | 100 | 4 | 7 | 4 | 7 | 0 | 5.71491 | 2.2 | 7.9149 | 6.219 | Opt | 35 | 0 |
| 47 | 0 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.21 | Opt | 1 | 0 |
| 48 | 0 | 0.2 | 0.8 | 0.01 | 100 | 100 | 11 | 7 | 11 | 7 | 0 | 3.72344 | 3.6 | 7.3234 | 9.684 | Opt | 137 | 0 |

| | INPUT | | | | | | OUTPUT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp | $f_{i'}$ | $h_i$ | $\alpha_r$ | $d_j$ | % ded | % shd | # ded | # shd | s ded | s shd | Fixed Cost | Transp Cost | Inv Cost | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 49 | 0.2 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 10.245 | Opt | 125 | 0 |
| 50 | 0.2 | 0 | 0.6 | 0.005 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 6.87 | Opt | 21 | 0 |
| 51 | 0.2 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.22 | Opt | 1 | 0 |
| 52 | 0.2 | 0 | 0.6 | 0.005 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 11.026 | Opt | 126 | 0 |
| 53 | 0.2 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 6.54961 | 0 | 6.5496 | 7.581 | Opt | 56 | 0 |
| 54 | 0.2 | 0 | 0.6 | 0.01 | 50 | 100 | 4 | 10 | 4 | 50 | 0.8 | 5.47648 | 0 | 6.2765 | 6.65 | Opt | 30 | 0 |
| 55 | 0.2 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.22 | Opt | 1 | 0 |
| 56 | 0.2 | 0 | 0.6 | 0.01 | 100 | 100 | 10 | 10 | 10 | 50 | 2 | 3.81669 | 0 | 5.8167 | 7.591 | Opt | 35 | 0 |
| 57 | 0.2 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 9.504 | Opt | 50 | 0 |
| 58 | 0.2 | 0 | 0.8 | 0.005 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 8.842 | Opt | 52 | 0 |
| 59 | 0.2 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.221 | Opt | 1 | 0 |
| 60 | 0.2 | 0 | 0.8 | 0.005 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 8.632 | Opt | 43 | 0 |
| 61 | 0.2 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 6.54961 | 0 | 6.5496 | 7.922 | Opt | 32 | 0 |
| 62 | 0.2 | 0 | 0.8 | 0.01 | 50 | 100 | 4 | 10 | 4 | 50 | 0.8 | 5.47648 | 0 | 6.2765 | 8.602 | Opt | 62 | 0 |
| 63 | 0.2 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.23 | Opt | 1 | 0 |
| 64 | 0.2 | 0 | 0.8 | 0.01 | 100 | 100 | 10 | 10 | 10 | 50 | 2 | 3.81669 | 0 | 5.8167 | 10.556 | Opt | 121 | 0 |
| 65 | 0.2 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 4.646 | Opt | 28 | 0 |
| 66 | 0.2 | 0.1 | 0.6 | 0.005 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 5.078 | Opt | 12 | 0 |
| 67 | 0.2 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.23 | Opt | 1 | 0 |
| 68 | 0.2 | 0.1 | 0.6 | 0.005 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 3.715 | Opt | 16 | 0 |
| 69 | 0.2 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 6.64784 | 0.8 | 7.4478 | 6.289 | Opt | 44 | 0 |
| 70 | 0.2 | 0.1 | 0.6 | 0.01 | 50 | 100 | 1 | 8 | 1 | 8 | 0.2 | 6.32973 | 0.9 | 7.4297 | 7.251 | Opt | 23 | 0 |
| 71 | 0.2 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.24 | Opt | 1 | 0 |
| 72 | 0.2 | 0.1 | 0.6 | 0.01 | 100 | 100 | 3 | 7 | 3 | 7 | 0.6 | 5.75431 | 1 | 7.3543 | 6.61 | Opt | 51 | 0 |
| 73 | 0.2 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 6.97 | Opt | 49 | 0 |
| 74 | 0.2 | 0.1 | 0.8 | 0.005 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 7.981 | Opt | 32 | 0 |
| 75 | 0.2 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.231 | Opt | 1 | 0 |
| 76 | 0.2 | 0.1 | 0.8 | 0.005 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 14.611 | Opt | 216 | 0 |
| 77 | 0.2 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 6.64784 | 0.8 | 7.4478 | 11.136 | Opt | 153 | 0 |
| 78 | 0.2 | 0.1 | 0.8 | 0.01 | 50 | 100 | 1 | 8 | 1 | 8 | 0.2 | 6.32973 | 0.9 | 7.4297 | 7.821 | Opt | 63 | 0 |
| 79 | 0.2 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.25 | Opt | 1 | 0 |
| 80 | 0.2 | 0.1 | 0.8 | 0.01 | 100 | 100 | 3 | 7 | 3 | 7 | 0.6 | 5.75431 | 1 | 7.3543 | 8.042 | Opt | 92 | 0 |
| 81 | 0.2 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 10.896 | Opt | 149 | 0 |
| 82 | 0.2 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 6.419 | Opt | 54 | 0 |
| 83 | 0.2 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.25 | Opt | 1 | 0 |
| 84 | 0.2 | 0.2 | 0.6 | 0.005 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 5.618 | Opt | 10 | 0 |
| 85 | 0.2 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 5.268 | Opt | 18 | 0 |
| 86 | 0.2 | 0.2 | 0.6 | 0.01 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 8.041 | Opt | 89 | 0 |
| 87 | 0.2 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.25 | Opt | 1 | 0 |
| 88 | 0.2 | 0.2 | 0.6 | 0.01 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 7.781 | Opt | 69 | 0 |
| 89 | 0.2 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 7.21 | Opt | 29 | 0 |
| 90 | 0.2 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 17.426 | Opt | 226 | 0 |
| 91 | 0.2 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.26 | Opt | 1 | 0 |
| 92 | 0.2 | 0.2 | 0.8 | 0.005 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 8.913 | Opt | 73 | 0 |
| 93 | 0.2 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 8.252 | Opt | 85 | 0 |
| 94 | 0.2 | 0.2 | 0.8 | 0.01 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 7.26 | Opt | 29 | 0 |
| 95 | 0.2 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.261 | Opt | 1 | 0 |
| 96 | 0.2 | 0.2 | 0.8 | 0.01 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 5.507 | Opt | 9 | 0 |

| | INPUT | | | | | | OUTPUT | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp | $f_{i'}$ | $h_i$ | $\alpha_r$ | $d_j$ | % ded | % shd | # ded | # shd | s ded | s shd | Fixed Cost | Transp Cost | Inv Cost | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 97 | 0.4 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 10.676 | Opt | 125 | 0 |
| 98 | 0.4 | 0 | 0.6 | 0.005 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 7.09 | Opt | 34 | 0 |
| 99 | 0.4 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.25 | Opt | 1 | 0 |
| 100 | 0.4 | 0 | 0.6 | 0.005 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 11.337 | Opt | 126 | 0 |
| 101 | 0.4 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 6.54961 | 0 | 6.5496 | 7.871 | Opt | 56 | 0 |
| 102 | 0.4 | 0 | 0.6 | 0.01 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 6.54961 | 0 | 6.5496 | 8.162 | Opt | 61 | 0 |
| 103 | 0.4 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.26 | Opt | 1 | 0 |
| 104 | 0.4 | 0 | 0.6 | 0.01 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 6.54961 | 0 | 6.5496 | 8.292 | Opt | 45 | 0 |
| 105 | 0.4 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 9.644 | Opt | 50 | 0 |
| 106 | 0.4 | 0 | 0.8 | 0.005 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 9.003 | Opt | 52 | 0 |
| 107 | 0.4 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.27 | Opt | 1 | 0 |
| 108 | 0.4 | 0 | 0.8 | 0.005 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 3.2748 | 0 | 3.2748 | 10.546 | Opt | 232 | 0 |
| 109 | 0.4 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 10 | 0 | 50 | 0 | 6.54961 | 0 | 6.5496 | 8.101 | Opt | 32 | 0 |
| 110 | 0.4 | 0 | 0.8 | 0.01 | 50 | 100 | 0 | 10 | 0 | 50 | 0 | 6.54961 | 0 | 6.5496 | 9.514 | Opt | 51 | 0 |
| 111 | 0.4 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.28 | Opt | 1 | 0 |
| 112 | 0.4 | 0 | 0.8 | 0.01 | 100 | 100 | 0 | 10 | 0 | 50 | 0 | 6.54961 | 0 | 6.5496 | 9.354 | Opt | 49 | 0 |
| 113 | 0.4 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 4.917 | Opt | 28 | 0 |
| 114 | 0.4 | 0.1 | 0.6 | 0.005 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 5.318 | Opt | 12 | 0 |
| 115 | 0.4 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.26 | Opt | 1 | 0 |
| 116 | 0.4 | 0.1 | 0.6 | 0.005 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 3.976 | Opt | 16 | 0 |
| 117 | 0.4 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 6.64784 | 0.8 | 7.4478 | 6.509 | Opt | 44 | 0 |
| 118 | 0.4 | 0.1 | 0.6 | 0.01 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 6.64784 | 0.8 | 7.4478 | 8.492 | Opt | 110 | 0 |
| 119 | 0.4 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.271 | Opt | 1 | 0 |
| 120 | 0.4 | 0.1 | 0.6 | 0.01 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 6.64784 | 0.8 | 7.4478 | 10.745 | Opt | 129 | 0 |
| 121 | 0.4 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 7.231 | Opt | 49 | 0 |
| 122 | 0.4 | 0.1 | 0.8 | 0.005 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 8.292 | Opt | 32 | 0 |
| 123 | 0.4 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.29 | Opt | 1 | 0 |
| 124 | 0.4 | 0.1 | 0.8 | 0.005 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 0.7 | 4.0981 | 13.94 | Opt | 195 | 0 |
| 125 | 0.4 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 8 | 0 | 8 | 0 | 6.64784 | 0.8 | 7.4478 | 11.447 | Opt | 153 | 0 |
| 126 | 0.4 | 0.1 | 0.8 | 0.01 | 50 | 100 | 0 | 8 | 0 | 8 | 0 | 6.64784 | 0.8 | 7.4478 | 5.988 | Opt | 15 | 0 |
| 127 | 0.4 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.271 | Opt | 1 | 0 |
| 128 | 0.4 | 0.1 | 0.8 | 0.01 | 100 | 100 | 0 | 8 | 0 | 8 | 0 | 6.64784 | 0.8 | 7.4478 | 8.322 | Opt | 103 | 0 |
| 129 | 0.4 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 11.216 | Opt | 149 | 0 |
| 130 | 0.4 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 6.629 | Opt | 54 | 0 |
| 131 | 0.4 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.271 | Opt | 1 | 0 |
| 132 | 0.4 | 0.2 | 0.6 | 0.005 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 5.788 | Opt | 10 | 0 |
| 133 | 0.4 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 5.498 | Opt | 18 | 0 |
| 134 | 0.4 | 0.2 | 0.6 | 0.01 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 9.063 | Opt | 58 | 0 |
| 135 | 0.4 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.28 | Opt | 1 | 0 |
| 136 | 0.4 | 0.2 | 0.6 | 0.01 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 6.8 | Opt | 33 | 0 |
| 137 | 0.4 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 7.441 | Opt | 29 | 0 |
| 138 | 0.4 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 17.876 | Opt | 226 | 0 |
| 139 | 0.4 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.29 | Opt | 1 | 0 |
| 140 | 0.4 | 0.2 | 0.8 | 0.005 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 3.39806 | 1.4 | 4.7981 | 9.133 | Opt | 73 | 0 |
| 141 | 0.4 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 8.412 | Opt | 85 | 0 |
| 142 | 0.4 | 0.2 | 0.8 | 0.01 | 50 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 7.541 | Opt | 29 | 0 |
| 143 | 0.4 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.291 | Opt | 1 | 0 |
| 144 | 0.4 | 0.2 | 0.8 | 0.01 | 100 | 100 | 0 | 7 | 0 | 7 | 0 | 6.79612 | 1.4 | 8.1961 | 7 | Opt | 18 | 0 |

# Appendix E – DOE Results for Customer-Centric Service Level Scenario

| | INPUT | | | | | | OUTPUT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp | $f_{i'}$ | $h_i$ | $\alpha_j$ | $d_j$ | % ded | % shd | # ded | # shd | s ded | s shd | Fixed Cost | Transp Cost | Inv Cost | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 1 | 0 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | Inf | 0 | 0 |
| 2 | 0 | 0 | 0.6 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | Inf | 0 | 0 |
| 3 | 0 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.19 | Opt | 1 | 0 |
| 4 | 0 | 0 | 0.6 | 0.005 | 100 | 100 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.251 | Opt | 1 | 0 |
| 5 | 0 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | Inf | 1 | 0 |
| 6 | 0 | 0 | 0.6 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.11 | Inf | 1 | 0 |
| 7 | 0 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.17 | Opt | 1 | 0 |
| 8 | 0 | 0 | 0.6 | 0.01 | 100 | 100 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.251 | Opt | 1 | 0 |
| 9 | 0 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.11 | Inf | 1 | 0 |
| 10 | 0 | 0 | 0.8 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.12 | Inf | 1 | 0 |
| 11 | 0 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.221 | Opt | 1 | 0 |
| 12 | 0 | 0 | 0.8 | 0.005 | 100 | 100 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.28 | Opt | 1 | 0 |
| 13 | 0 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.13 | Inf | 1 | 0 |
| 14 | 0 | 0 | 0.8 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.11 | Inf | 1 | 0 |
| 15 | 0 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.201 | Opt | 1 | 0 |
| 16 | 0 | 0 | 0.8 | 0.01 | 100 | 100 | 50 | 0 | 50 | 0 | 0 | 0 | 0 | 0 | 0.27 | Opt | 1 | 0 |
| 17 | 0 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.12 | Inf | 1 | 0 |
| 18 | 0 | 0.1 | 0.6 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.11 | Inf | 1 | 0 |
| 19 | 0 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.201 | Opt | 1 | 0 |
| 20 | 0 | 0.1 | 0.6 | 0.005 | 100 | 100 | 11 | 7 | 11 | 7 | 0 | 1.86172 | 1.8 | 3.6617 | 3.825 | Opt | 7 | 0 |
| 21 | 0 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.11 | Inf | 7 | 0 |
| 22 | 0 | 0.1 | 0.6 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.121 | Inf | 7 | 0 |
| 23 | 0 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.2 | Opt | 1 | 0 |
| 24 | 0 | 0.1 | 0.6 | 0.01 | 100 | 100 | 31 | 4 | 31 | 4 | 0 | 1.22778 | 3.5 | 4.7278 | 2.834 | Opt | 3 | 0 |
| 25 | 0 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.13 | Inf | 3 | 0 |
| 26 | 0 | 0.1 | 0.8 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.12 | Inf | 3 | 0 |
| 27 | 0 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.271 | Opt | 1 | 0 |
| 28 | 0 | 0.1 | 0.8 | 0.005 | 100 | 100 | 11 | 7 | 11 | 7 | 0 | 1.86172 | 1.8 | 3.6617 | 1.893 | Opt | 1 | 0 |
| 29 | 0 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.12 | Inf | 1 | 0 |
| 30 | 0 | 0.1 | 0.8 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.13 | Inf | 1 | 0 |
| 31 | 0 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 5 | 5 | 0.24 | Opt | 1 | 0 |
| 32 | 0 | 0.1 | 0.8 | 0.01 | 100 | 100 | 31 | 4 | 31 | 4 | 0 | 1.22778 | 3.5 | 4.7278 | 2.093 | Opt | 1 | 0 |
| 33 | 0 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.131 | Inf | 1 | 0 |
| 34 | 0 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.13 | Inf | 1 | 0 |
| 35 | 0 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.21 | Opt | 1 | 0 |
| 36 | 0 | 0.2 | 0.6 | 0.005 | 100 | 100 | 3 | 7 | 3 | 7 | 0 | 2.87716 | 2 | 4.8772 | 4.937 | Opt | 28 | 0 |
| 37 | 0 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.13 | Inf | 28 | 0 |
| 38 | 0 | 0.2 | 0.6 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.121 | Inf | 28 | 0 |
| 39 | 0 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.22 | Opt | 1 | 0 |
| 40 | 0 | 0.2 | 0.6 | 0.01 | 100 | 100 | 11 | 7 | 11 | 7 | 0 | 3.72344 | 3.6 | 7.3234 | 4.346 | Opt | 20 | 0 |
| 41 | 0 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.13 | Inf | 20 | 0 |
| 42 | 0 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.141 | Inf | 20 | 0 |
| 43 | 0 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.21 | Opt | 1 | 0 |
| 44 | 0 | 0.2 | 0.8 | 0.005 | 100 | 100 | 3 | 7 | 3 | 7 | 0 | 2.87716 | 2 | 4.8772 | 6.579 | Opt | 58 | 0 |
| 45 | 0 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.141 | Inf | 58 | 0 |
| 46 | 0 | 0.2 | 0.8 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.14 | Inf | 58 | 0 |
| 47 | 0 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 0 | 0 | 10 | 10 | 0.22 | Opt | 1 | 0 |
| 48 | 0 | 0.2 | 0.8 | 0.01 | 100 | 100 | 11 | 7 | 11 | 7 | 0 | 3.72344 | 3.6 | 7.3234 | 6.66 | Opt | 59 | 0 |

| | INPUT | | | | | | OUTPUT | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp | $f_{i'}$ | $h_i$ | $\alpha_j$ | $d_j$ | % ded | % shd | # ded | # shd | s ded | s shd | Fixed Cost | Transp Cost | Inv Cost | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 49 | 0.2 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.14 | Inf | 59 | 0 |
| 50 | 0.2 | 0 | 0.6 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.15 | Inf | 59 | 0 |
| 51 | 0.2 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.221 | Opt | 1 | 0 |
| 52 | 0.2 | 0 | 0.6 | 0.005 | 100 | 100 | 2 | 10 | 2 | 50 | 0.4 | 2.95059 | 0 | 3.3506 | 6.359 | Opt | 49 | 0 |
| 53 | 0.2 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.14 | Inf | 49 | 0 |
| 54 | 0.2 | 0 | 0.6 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.14 | Inf | 49 | 0 |
| 55 | 0.2 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.23 | Opt | 1 | 0 |
| 56 | 0.2 | 0 | 0.6 | 0.01 | 100 | 100 | 10 | 10 | 10 | 50 | 2 | 3.81669 | 0 | 5.8167 | 6.709 | Opt | 59 | 0 |
| 57 | 0.2 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.14 | Inf | 59 | 0 |
| 58 | 0.2 | 0 | 0.8 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.151 | Inf | 59 | 0 |
| 59 | 0.2 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.23 | Opt | 1 | 0 |
| 60 | 0.2 | 0 | 0.8 | 0.005 | 100 | 100 | 2 | 10 | 2 | 50 | 0.4 | 2.95059 | 0 | 3.3506 | 8.092 | Opt | 144 | 0 |
| 61 | 0.2 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.14 | Inf | 144 | 0 |
| 62 | 0.2 | 0 | 0.8 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.15 | Inf | 144 | 0 |
| 63 | 0.2 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 0 | 10 | 0.24 | Opt | 1 | 0 |
| 64 | 0.2 | 0 | 0.8 | 0.01 | 100 | 100 | 10 | 10 | 10 | 50 | 2 | 3.81669 | 0 | 5.8167 | 9.204 | Opt | 155 | 0 |
| 65 | 0.2 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.15 | Inf | 155 | 0 |
| 66 | 0.2 | 0.1 | 0.6 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.15 | Inf | 155 | 0 |
| 67 | 0.2 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.231 | Opt | 1 | 0 |
| 68 | 0.2 | 0.1 | 0.6 | 0.005 | 100 | 100 | 2 | 7 | 2 | 7 | 0.4 | 3.07855 | 0.9 | 4.3786 | 6.96 | Opt | 48 | 0 |
| 69 | 0.2 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.15 | Inf | 48 | 0 |
| 70 | 0.2 | 0.1 | 0.6 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.15 | Inf | 48 | 0 |
| 71 | 0.2 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.24 | Opt | 1 | 0 |
| 72 | 0.2 | 0.1 | 0.6 | 0.01 | 100 | 100 | 3 | 7 | 3 | 7 | 0.6 | 5.75431 | 1 | 7.3543 | 3.956 | Opt | 3 | 0 |
| 73 | 0.2 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.16 | Inf | 3 | 0 |
| 74 | 0.2 | 0.1 | 0.8 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.161 | Inf | 3 | 0 |
| 75 | 0.2 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.24 | Opt | 1 | 0 |
| 76 | 0.2 | 0.1 | 0.8 | 0.005 | 100 | 100 | 2 | 7 | 2 | 7 | 0.4 | 3.07855 | 0.9 | 4.3786 | 5.688 | Opt | 33 | 0 |
| 77 | 0.2 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.16 | Inf | 33 | 0 |
| 78 | 0.2 | 0.1 | 0.8 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.161 | Inf | 33 | 0 |
| 79 | 0.2 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 5 | 15 | 0.24 | Opt | 1 | 0 |
| 80 | 0.2 | 0.1 | 0.8 | 0.01 | 100 | 100 | 3 | 7 | 3 | 7 | 0.6 | 5.75431 | 1 | 7.3543 | 5.478 | Opt | 44 | 0 |
| 81 | 0.2 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.16 | Inf | 44 | 0 |
| 82 | 0.2 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.16 | Inf | 44 | 0 |
| 83 | 0.2 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.241 | Opt | 1 | 0 |
| 84 | 0.2 | 0.2 | 0.6 | 0.005 | 100 | 100 | 2 | 7 | 2 | 7 | 0.4 | 3.07855 | 1.8 | 5.2786 | 4.606 | Opt | 23 | 0 |
| 85 | 0.2 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.161 | Inf | 23 | 0 |
| 86 | 0.2 | 0.2 | 0.6 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.16 | Inf | 23 | 0 |
| 87 | 0.2 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.25 | Opt | 1 | 0 |
| 88 | 0.2 | 0.2 | 0.6 | 0.01 | 100 | 100 | 3 | 7 | 3 | 7 | 0.6 | 5.75431 | 2 | 8.3543 | 4.947 | Opt | 12 | 0 |
| 89 | 0.2 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.161 | Inf | 12 | 0 |
| 90 | 0.2 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.16 | Inf | 12 | 0 |
| 91 | 0.2 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.27 | Opt | 1 | 0 |
| 92 | 0.2 | 0.2 | 0.8 | 0.005 | 100 | 100 | 2 | 7 | 2 | 7 | 0.4 | 3.07855 | 1.8 | 5.2786 | 7.621 | Opt | 60 | 0 |
| 93 | 0.2 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.171 | Inf | 60 | 0 |
| 94 | 0.2 | 0.2 | 0.8 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.17 | Inf | 60 | 0 |
| 95 | 0.2 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 10 | 0 | 10 | 20 | 0.25 | Opt | 1 | 0 |
| 96 | 0.2 | 0.2 | 0.8 | 0.01 | 100 | 100 | 3 | 7 | 3 | 7 | 0.6 | 5.75431 | 2 | 8.3543 | 4.276 | Opt | 32 | 0 |

| | INPUT | | | | | | OUTPUT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp | $f_{i'}$ | $h_i$ | $\alpha_j$ | $d_j$ | % ded | % shd | # ded | # shd | s ded | s shd | Fixed Cost | Transp Cost | Inv Cost | Obj Val | Sol Time | Status | B&B nodes | Opt Gap |
| 97 | 0.4 | 0 | 0.6 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.171 | Inf | 32 | 0 |
| 98 | 0.4 | 0 | 0.6 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.18 | Inf | 32 | 0 |
| 99 | 0.4 | 0 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.26 | Opt | 1 | 0 |
| 100 | 0.4 | 0 | 0.6 | 0.005 | 100 | 100 | 2 | 10 | 2 | 50 | 0.8 | 2.95059 | 0 | 3.7506 | 6.7 | Opt | 49 | 0 |
| 101 | 0.4 | 0 | 0.6 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.17 | Inf | 49 | 0 |
| 102 | 0.4 | 0 | 0.6 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.16 | Inf | 49 | 0 |
| 103 | 0.4 | 0 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.251 | Opt | 1 | 0 |
| 104 | 0.4 | 0 | 0.6 | 0.01 | 100 | 100 | 2 | 10 | 2 | 50 | 0.8 | 5.90119 | 0 | 6.7012 | 7 | Opt | 51 | 0 |
| 105 | 0.4 | 0 | 0.8 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.17 | Inf | 51 | 0 |
| 106 | 0.4 | 0 | 0.8 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.17 | Inf | 51 | 0 |
| 107 | 0.4 | 0 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.261 | Opt | 1 | 0 |
| 108 | 0.4 | 0 | 0.8 | 0.005 | 100 | 100 | 2 | 10 | 2 | 50 | 0.8 | 2.95059 | 0 | 3.7506 | 8.432 | Opt | 132 | 0 |
| 109 | 0.4 | 0 | 0.8 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.18 | Inf | 132 | 0 |
| 110 | 0.4 | 0 | 0.8 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.181 | Inf | 132 | 0 |
| 111 | 0.4 | 0 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 0 | 20 | 0.26 | Opt | 1 | 0 |
| 112 | 0.4 | 0 | 0.8 | 0.01 | 100 | 100 | 2 | 10 | 2 | 50 | 0.8 | 5.90119 | 0 | 6.7012 | 7.881 | Opt | 71 | 0 |
| 113 | 0.4 | 0.1 | 0.6 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.171 | Inf | 71 | 0 |
| 114 | 0.4 | 0.1 | 0.6 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.17 | Inf | 71 | 0 |
| 115 | 0.4 | 0.1 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.28 | Opt | 1 | 0 |
| 116 | 0.4 | 0.1 | 0.6 | 0.005 | 100 | 100 | 2 | 7 | 2 | 7 | 0.8 | 3.07855 | 0.9 | 4.7786 | 7.461 | Opt | 52 | 0 |
| 117 | 0.4 | 0.1 | 0.6 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.18 | Inf | 52 | 0 |
| 118 | 0.4 | 0.1 | 0.6 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.191 | Inf | 52 | 0 |
| 119 | 0.4 | 0.1 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.27 | Opt | 1 | 0 |
| 120 | 0.4 | 0.1 | 0.6 | 0.01 | 100 | 100 | 2 | 8 | 2 | 8 | 0.8 | 5.99942 | 1 | 7.7994 | 4.847 | Opt | 21 | 0 |
| 121 | 0.4 | 0.1 | 0.8 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.19 | Inf | 21 | 0 |
| 122 | 0.4 | 0.1 | 0.8 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.191 | Inf | 21 | 0 |
| 123 | 0.4 | 0.1 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.27 | Opt | 1 | 0 |
| 124 | 0.4 | 0.1 | 0.8 | 0.005 | 100 | 100 | 2 | 7 | 2 | 7 | 0.8 | 3.07855 | 0.9 | 4.7786 | 6.71 | Opt | 41 | 0 |
| 125 | 0.4 | 0.1 | 0.8 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.19 | Inf | 41 | 0 |
| 126 | 0.4 | 0.1 | 0.8 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.19 | Inf | 41 | 0 |
| 127 | 0.4 | 0.1 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 5 | 25 | 0.281 | Opt | 1 | 0 |
| 128 | 0.4 | 0.1 | 0.8 | 0.01 | 100 | 100 | 2 | 8 | 2 | 8 | 0.8 | 5.99942 | 1 | 7.7994 | 5.357 | Opt | 42 | 0 |
| 129 | 0.4 | 0.2 | 0.6 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.191 | Inf | 42 | 0 |
| 130 | 0.4 | 0.2 | 0.6 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.19 | Inf | 42 | 0 |
| 131 | 0.4 | 0.2 | 0.6 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.29 | Opt | 1 | 0 |
| 132 | 0.4 | 0.2 | 0.6 | 0.005 | 100 | 100 | 2 | 7 | 2 | 7 | 0.8 | 3.07855 | 1.8 | 5.6786 | 4.707 | Opt | 23 | 0 |
| 133 | 0.4 | 0.2 | 0.6 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | Inf | 23 | 0 |
| 134 | 0.4 | 0.2 | 0.6 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.201 | Inf | 23 | 0 |
| 135 | 0.4 | 0.2 | 0.6 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.28 | Opt | 1 | 0 |
| 136 | 0.4 | 0.2 | 0.6 | 0.01 | 100 | 100 | 2 | 7 | 2 | 7 | 0.8 | 6.15709 | 1.8 | 8.7571 | 5.568 | Opt | 26 | 0 |
| 137 | 0.4 | 0.2 | 0.8 | 0.005 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.191 | Inf | 26 | 0 |
| 138 | 0.4 | 0.2 | 0.8 | 0.005 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | Inf | 26 | 0 |
| 139 | 0.4 | 0.2 | 0.8 | 0.005 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.28 | Opt | 1 | 0 |
| 140 | 0.4 | 0.2 | 0.8 | 0.005 | 100 | 100 | 2 | 7 | 2 | 7 | 0.8 | 3.07855 | 1.8 | 5.6786 | 7.892 | Opt | 60 | 0 |
| 141 | 0.4 | 0.2 | 0.8 | 0.01 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.19 | Inf | 60 | 0 |
| 142 | 0.4 | 0.2 | 0.8 | 0.01 | 50 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | Inf | 60 | 0 |
| 143 | 0.4 | 0.2 | 0.8 | 0.01 | 100 | 0 | 50 | 0 | 50 | 0 | 20 | 0 | 10 | 30 | 0.291 | Opt | 1 | 0 |
| 144 | 0.4 | 0.2 | 0.8 | 0.01 | 100 | 100 | 2 | 7 | 2 | 7 | 0.8 | 6.15709 | 1.8 | 8.7571 | 6.479 | Opt | 33 | 0 |

# Appendix F – Risk Pooling DOE

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 100 | 0.75 | 0.001 | 1.0135 | 1.014 | 0 |
| 100 | 0.75 | 0.002 | 1.0135 | 1.014 | 0 |
| 100 | 0.75 | 0.003 | 1.0135 | 1.014 | 0 |
| 100 | 0.75 | 0.004 | 1.0152 | 1.143 | 0.1277 |
| 100 | 0.75 | 0.005 | 1.0172 | 1.067 | 0.0494 |
| 100 | 0.75 | 0.006 | 1.0192 | 1.048 | 0.0284 |
| 100 | 0.75 | 0.007 | 1.0213 | 1.038 | 0.0172 |
| 100 | 0.75 | 0.008 | 1.0233 | 1.033 | 0.0101 |
| 100 | 0.75 | 0.009 | 1.025 | 1.03 | 0.0053 |
| 100 | 0.75 | 0.01 | 1.0263 | 1.029 | 0.0023 |
| 100 | 0.8 | 0.001 | 1.0127 | 1.013 | 0 |
| 100 | 0.8 | 0.002 | 1.0127 | 1.013 | 0 |
| 100 | 0.8 | 0.003 | 1.0141 | 1.143 | 0.1288 |
| 100 | 0.8 | 0.004 | 1.0167 | 1.056 | 0.0389 |
| 100 | 0.8 | 0.005 | 1.0189 | 1.04 | 0.0211 |
| 100 | 0.8 | 0.006 | 1.0213 | 1.032 | 0.011 |
| 100 | 0.8 | 0.007 | 1.0233 | 1.029 | 0.0053 |
| 100 | 0.8 | 0.008 | 1.0256 | 1.026 | 0 |
| 100 | 0.8 | 0.009 | 1.0256 | 1.026 | 0 |
| 100 | 0.8 | 0.01 | 1.0256 | 1.026 | 0 |
| 100 | 0.85 | 0.001 | 1.0119 | 1.012 | 0 |
| 100 | 0.85 | 0.002 | 1.0128 | 1.2 | 0.1872 |
| 100 | 0.85 | 0.003 | 1.0161 | 1.048 | 0.0315 |
| 100 | 0.85 | 0.004 | 1.0189 | 1.033 | 0.0145 |
| 100 | 0.85 | 0.005 | 1.0217 | 1.027 | 0.0053 |
| 100 | 0.85 | 0.006 | 1.0238 | 1.024 | 0.0006 |
| 100 | 0.85 | 0.007 | 1.0241 | 1.024 | 0 |
| 100 | 0.85 | 0.008 | 1.0244 | 1.043 | 0.0182 |
| 100 | 0.85 | 0.009 | 1.0263 | 1.167 | 0.1404 |
| 100 | 0.85 | 0.01 | 1.0286 | 1.083 | 0.0548 |
| 100 | 0.9 | 0.001 | 1.0112 | 1.011 | 0 |
| 100 | 0.9 | 0.002 | 1.0156 | 1.042 | 0.026 |
| 100 | 0.9 | 0.003 | 1.0196 | 1.027 | 0.0074 |
| 100 | 0.9 | 0.004 | 1.0227 | 1.023 | 0 |
| 100 | 0.9 | 0.005 | 1.0227 | 1.023 | 0 |
| 100 | 0.9 | 0.006 | 1.023 | 1.038 | 0.0155 |
| 100 | 0.9 | 0.007 | 1.0256 | 1.111 | 0.0855 |
| 100 | 0.9 | 0.008 | 1.0278 | 1.067 | 0.0389 |
| 100 | 0.9 | 0.009 | 1.0303 | 1.048 | 0.0173 |
| 100 | 0.9 | 0.01 | 1.0328 | 1.038 | 0.0057 |
| 100 | 0.94 | 0.001 | 1.0137 | 1.053 | 0.0389 |
| 100 | 0.94 | 0.002 | 1.02 | 1.024 | 0.0038 |
| 100 | 0.94 | 0.003 | 1.0217 | 1.022 | 0 |
| 100 | 0.94 | 0.004 | 1.0217 | 1.022 | 0 |
| 100 | 0.94 | 0.005 | 1.0244 | 1.111 | 0.0867 |
| 100 | 0.94 | 0.006 | 1.0274 | 1.056 | 0.0282 |
| 100 | 0.94 | 0.007 | 1.0308 | 1.038 | 0.0077 |
| 100 | 0.94 | 0.008 | 1.033 | 1.033 | 0 |
| 100 | 0.94 | 0.009 | 1.033 | 1.033 | 0 |
| 100 | 0.94 | 0.01 | 1.0337 | 2 | 0.9663 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 100 | 0.95 | 0.001 | 1.0149 | 1.038 | 0.0235 |
| 100 | 0.95 | 0.002 | 1.0215 | 1.022 | 0 |
| 100 | 0.95 | 0.003 | 1.0215 | 1.022 | 0 |
| 100 | 0.95 | 0.004 | 1.0222 | 1.5 | 0.4778 |
| 100 | 0.95 | 0.005 | 1.026 | 1.067 | 0.0407 |
| 100 | 0.95 | 0.006 | 1.0294 | 1.042 | 0.0123 |
| 100 | 0.95 | 0.007 | 1.0326 | 1.033 | 0 |
| 100 | 0.95 | 0.008 | 1.0326 | 1.033 | 0 |
| 100 | 0.95 | 0.009 | 1.033 | 1.051 | 0.0183 |
| 100 | 0.95 | 0.01 | 1.0353 | 1.167 | 0.1314 |
| 100 | 0.96 | 0.001 | 1.0167 | 1.029 | 0.0127 |
| 100 | 0.96 | 0.002 | 1.0213 | 1.021 | 0 |
| 100 | 0.96 | 0.003 | 1.0213 | 1.021 | 0 |
| 100 | 0.96 | 0.004 | 1.0241 | 1.1 | 0.0759 |
| 100 | 0.96 | 0.005 | 1.0282 | 1.045 | 0.0173 |
| 100 | 0.96 | 0.006 | 1.0317 | 1.033 | 0.0016 |
| 100 | 0.96 | 0.007 | 1.0323 | 1.032 | 0 |
| 100 | 0.96 | 0.008 | 1.0323 | 1.032 | 0 |
| 100 | 0.96 | 0.009 | 1.0349 | 1.167 | 0.1318 |
| 100 | 0.96 | 0.01 | 1.038 | 1.077 | 0.0389 |
| 100 | 0.97 | 0.001 | 1.0192 | 1.023 | 0.004 |
| 100 | 0.97 | 0.002 | 1.0211 | 1.021 | 0 |
| 100 | 0.97 | 0.003 | 1.022 | 1.333 | 0.3114 |
| 100 | 0.97 | 0.004 | 1.0267 | 1.053 | 0.026 |
| 100 | 0.97 | 0.005 | 1.0313 | 1.033 | 0.0021 |
| 100 | 0.97 | 0.006 | 1.0319 | 1.032 | 0 |
| 100 | 0.97 | 0.007 | 1.0319 | 1.032 | 0 |
| 100 | 0.97 | 0.008 | 1.0349 | 1.143 | 0.108 |
| 100 | 0.97 | 0.009 | 1.038 | 1.071 | 0.0335 |
| 100 | 0.97 | 0.01 | 1.0411 | 1.05 | 0.0089 |
| 100 | 0.98 | 0.001 | 1.0208 | 1.021 | 0 |
| 100 | 0.98 | 0.002 | 1.0208 | 1.021 | 0 |
| 100 | 0.98 | 0.003 | 1.0256 | 1.059 | 0.0332 |
| 100 | 0.98 | 0.004 | 1.0308 | 1.033 | 0.0026 |
| 100 | 0.98 | 0.005 | 1.0316 | 1.032 | 0 |
| 100 | 0.98 | 0.006 | 1.0316 | 1.032 | 0 |
| 100 | 0.98 | 0.007 | 1.0357 | 1.1 | 0.0643 |
| 100 | 0.98 | 0.008 | 1.0395 | 1.056 | 0.0161 |
| 100 | 0.98 | 0.009 | 1.0426 | 1.043 | 0 |
| 100 | 0.98 | 0.01 | 1.0426 | 1.043 | 0 |
| 100 | 0.99 | 0.001 | 1.0206 | 1.021 | 0 |
| 100 | 0.99 | 0.002 | 1.025 | 1.063 | 0.0375 |
| 100 | 0.99 | 0.003 | 1.0313 | 1.031 | 0 |
| 100 | 0.99 | 0.004 | 1.0313 | 1.031 | 0 |
| 100 | 0.99 | 0.005 | 1.0337 | 1.167 | 0.133 |
| 100 | 0.99 | 0.006 | 1.0385 | 1.059 | 0.0204 |
| 100 | 0.99 | 0.007 | 1.0421 | 1.042 | 0 |
| 100 | 0.99 | 0.008 | 1.0421 | 1.042 | 0 |
| 100 | 0.99 | 0.009 | 1.0435 | 1.5 | 0.4565 |
| 100 | 0.99 | 0.01 | 1.0476 | 1.1 | 0.0524 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 200 | 0.75 | 0.001 | 1.0067 | 1.007 | 0 |
| 200 | 0.75 | 0.002 | 1.0075 | 1.071 | 0.064 |
| 200 | 0.75 | 0.003 | 1.0095 | 1.023 | 0.0137 |
| 200 | 0.75 | 0.004 | 1.0114 | 1.017 | 0.0053 |
| 200 | 0.75 | 0.005 | 1.013 | 1.014 | 0.0011 |
| 200 | 0.75 | 0.006 | 1.0135 | 1.014 | 0 |
| 200 | 0.75 | 0.007 | 1.015 | 1.071 | 0.0564 |
| 200 | 0.75 | 0.008 | 1.0165 | 1.038 | 0.0219 |
| 200 | 0.75 | 0.009 | 1.018 | 1.028 | 0.0098 |
| 200 | 0.75 | 0.01 | 1.0194 | 1.023 | 0.0033 |
| 200 | 0.8 | 0.001 | 1.0063 | 1.006 | 0 |
| 200 | 0.8 | 0.002 | 1.0083 | 1.027 | 0.0188 |
| 200 | 0.8 | 0.003 | 1.0104 | 1.016 | 0.0057 |
| 200 | 0.8 | 0.004 | 1.0125 | 1.013 | 0.0003 |
| 200 | 0.8 | 0.005 | 1.0127 | 1.013 | 0 |
| 200 | 0.8 | 0.006 | 1.0144 | 1.056 | 0.0412 |
| 200 | 0.8 | 0.007 | 1.0161 | 1.03 | 0.0142 |
| 200 | 0.8 | 0.008 | 1.0177 | 1.023 | 0.005 |
| 200 | 0.8 | 0.009 | 1.0191 | 1.019 | 0 |
| 200 | 0.8 | 0.01 | 1.0197 | 1.25 | 0.2303 |
| 200 | 0.85 | 0.001 | 1.0064 | 1.091 | 0.0845 |
| 200 | 0.85 | 0.002 | 1.0093 | 1.016 | 0.007 |
| 200 | 0.85 | 0.003 | 1.0118 | 1.012 | 0.0003 |
| 200 | 0.85 | 0.004 | 1.012 | 1.021 | 0.0089 |
| 200 | 0.85 | 0.005 | 1.014 | 1.042 | 0.0277 |
| 200 | 0.85 | 0.006 | 1.0159 | 1.024 | 0.0085 |
| 200 | 0.85 | 0.007 | 1.0175 | 1.019 | 0.0013 |
| 200 | 0.85 | 0.008 | 1.018 | 1.018 | 0 |
| 200 | 0.85 | 0.009 | 1.0196 | 1.077 | 0.0573 |
| 200 | 0.85 | 0.01 | 1.0213 | 1.04 | 0.0187 |
| 200 | 0.9 | 0.001 | 1.0077 | 1.021 | 0.0131 |
| 200 | 0.9 | 0.002 | 1.0112 | 1.011 | 0 |
| 200 | 0.9 | 0.003 | 1.0113 | 1.019 | 0.0076 |
| 200 | 0.9 | 0.004 | 1.0137 | 1.032 | 0.0186 |
| 200 | 0.9 | 0.005 | 1.016 | 1.019 | 0.0032 |
| 200 | 0.9 | 0.006 | 1.0169 | 1.017 | 0 |
| 200 | 0.9 | 0.007 | 1.0183 | 1.083 | 0.065 |
| 200 | 0.9 | 0.008 | 1.0201 | 1.037 | 0.0169 |
| 200 | 0.9 | 0.009 | 1.0221 | 1.025 | 0.0029 |
| 200 | 0.9 | 0.01 | 1.0227 | 1.023 | 0 |
| 200 | 0.94 | 0.001 | 1.0098 | 1.012 | 0.0021 |
| 200 | 0.94 | 0.002 | 1.0108 | 1.011 | 0 |
| 200 | 0.94 | 0.003 | 1.0135 | 1.027 | 0.0135 |
| 200 | 0.94 | 0.004 | 1.0162 | 1.016 | 0 |
| 200 | 0.94 | 0.005 | 1.0165 | 1.5 | 0.4835 |
| 200 | 0.94 | 0.006 | 1.0189 | 1.04 | 0.0211 |
| 200 | 0.94 | 0.007 | 1.0211 | 1.024 | 0.0027 |
| 200 | 0.94 | 0.008 | 1.0217 | 1.022 | 0 |
| 200 | 0.94 | 0.009 | 1.0234 | 1.083 | 0.0599 |
| 200 | 0.94 | 0.01 | 1.0255 | 1.038 | 0.013 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 200 | 0.95 | 0.001 | 1.0106 | 1.011 | 0 |
| 200 | 0.95 | 0.002 | 1.011 | 1.2 | 0.189 |
| 200 | 0.95 | 0.003 | 1.0144 | 1.021 | 0.0064 |
| 200 | 0.95 | 0.004 | 1.016 | 1.016 | 0 |
| 200 | 0.95 | 0.005 | 1.0173 | 1.077 | 0.0596 |
| 200 | 0.95 | 0.006 | 1.0199 | 1.029 | 0.0087 |
| 200 | 0.95 | 0.007 | 1.0215 | 1.022 | 0 |
| 200 | 0.95 | 0.008 | 1.0223 | 1.167 | 0.1443 |
| 200 | 0.95 | 0.009 | 1.0245 | 1.045 | 0.0209 |
| 200 | 0.95 | 0.01 | 1.0267 | 1.029 | 0.0019 |
| 200 | 0.96 | 0.001 | 1.0105 | 1.011 | 0 |
| 200 | 0.96 | 0.002 | 1.0119 | 1.048 | 0.0357 |
| 200 | 0.96 | 0.003 | 1.0156 | 1.016 | 0.0008 |
| 200 | 0.96 | 0.004 | 1.0159 | 1.016 | 0 |
| 200 | 0.96 | 0.005 | 1.0185 | 1.038 | 0.0199 |
| 200 | 0.96 | 0.006 | 1.0211 | 1.022 | 0.0006 |
| 200 | 0.96 | 0.007 | 1.0214 | 1.033 | 0.0114 |
| 200 | 0.96 | 0.008 | 1.0237 | 1.056 | 0.0319 |
| 200 | 0.96 | 0.009 | 1.026 | 1.03 | 0.0043 |
| 200 | 0.96 | 0.01 | 1.0267 | 1.027 | 0 |
| 200 | 0.97 | 0.001 | 1.0104 | 1.01 | 0 |
| 200 | 0.97 | 0.002 | 1.0132 | 1.026 | 0.0125 |
| 200 | 0.97 | 0.003 | 1.0157 | 1.016 | 0 |
| 200 | 0.97 | 0.004 | 1.0171 | 1.067 | 0.0495 |
| 200 | 0.97 | 0.005 | 1.0201 | 1.024 | 0.0043 |
| 200 | 0.97 | 0.006 | 1.0211 | 1.021 | 0 |
| 200 | 0.97 | 0.007 | 1.023 | 1.067 | 0.0437 |
| 200 | 0.97 | 0.008 | 1.0255 | 1.031 | 0.0058 |
| 200 | 0.97 | 0.009 | 1.0265 | 1.026 | 0 |
| 200 | 0.97 | 0.01 | 1.0279 | 1.111 | 0.0832 |
| 200 | 0.98 | 0.001 | 1.0103 | 1.01 | 0 |
| 200 | 0.98 | 0.002 | 1.0152 | 1.016 | 0.0012 |
| 200 | 0.98 | 0.003 | 1.0155 | 1.016 | 0 |
| 200 | 0.98 | 0.004 | 1.0192 | 1.028 | 0.0085 |
| 200 | 0.98 | 0.005 | 1.0208 | 1.021 | 0 |
| 200 | 0.98 | 0.006 | 1.0225 | 1.077 | 0.0545 |
| 200 | 0.98 | 0.007 | 1.0253 | 1.03 | 0.005 |
| 200 | 0.98 | 0.008 | 1.0262 | 1.026 | 0 |
| 200 | 0.98 | 0.009 | 1.0281 | 1.083 | 0.0552 |
| 200 | 0.98 | 0.01 | 1.0305 | 1.038 | 0.008 |
| 200 | 0.99 | 0.001 | 1.0123 | 1.031 | 0.019 |
| 200 | 0.99 | 0.002 | 1.0154 | 1.015 | 0 |
| 200 | 0.99 | 0.003 | 1.0189 | 1.029 | 0.0097 |
| 200 | 0.99 | 0.004 | 1.0206 | 1.021 | 0 |
| 200 | 0.99 | 0.005 | 1.0231 | 1.05 | 0.0269 |
| 200 | 0.99 | 0.006 | 1.0259 | 1.026 | 0 |
| 200 | 0.99 | 0.007 | 1.0266 | 1.25 | 0.2234 |
| 200 | 0.99 | 0.008 | 1.0296 | 1.043 | 0.0139 |
| 200 | 0.99 | 0.009 | 1.0313 | 1.031 | 0 |
| 200 | 0.99 | 0.01 | 1.0326 | 1.143 | 0.1102 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 300 | 0.75 | 0.001 | 1.0045 | 1.004 | 0 |
| 300 | 0.75 | 0.002 | 1.0063 | 1.015 | 0.0091 |
| 300 | 0.75 | 0.003 | 1.0081 | 1.01 | 0.002 |
| 300 | 0.75 | 0.004 | 1.009 | 1.009 | 0 |
| 300 | 0.75 | 0.005 | 1.0104 | 1.033 | 0.0229 |
| 300 | 0.75 | 0.006 | 1.0119 | 1.019 | 0.0066 |
| 300 | 0.75 | 0.007 | 1.0133 | 1.014 | 0.0006 |
| 300 | 0.75 | 0.008 | 1.0142 | 1.111 | 0.097 |
| 300 | 0.75 | 0.009 | 1.0155 | 1.037 | 0.0216 |
| 300 | 0.75 | 0.01 | 1.0168 | 1.024 | 0.007 |
| 300 | 0.8 | 0.001 | 1.0047 | 1.043 | 0.0388 |
| 300 | 0.8 | 0.002 | 1.0069 | 1.011 | 0.0037 |
| 300 | 0.8 | 0.003 | 1.0084 | 1.008 | 0 |
| 300 | 0.8 | 0.004 | 1.0096 | 1.036 | 0.0261 |
| 300 | 0.8 | 0.005 | 1.0112 | 1.017 | 0.0061 |
| 300 | 0.8 | 0.006 | 1.0127 | 1.013 | 0 |
| 300 | 0.8 | 0.007 | 1.0135 | 1.071 | 0.0579 |
| 300 | 0.8 | 0.008 | 1.0149 | 1.029 | 0.0136 |
| 300 | 0.8 | 0.009 | 1.0164 | 1.019 | 0.0025 |
| 300 | 0.8 | 0.01 | 1.0172 | 1.333 | 0.3161 |
| 300 | 0.85 | 0.001 | 1.0053 | 1.016 | 0.0103 |
| 300 | 0.85 | 0.002 | 1.0078 | 1.008 | 0.0002 |
| 300 | 0.85 | 0.003 | 1.0086 | 1.05 | 0.0414 |
| 300 | 0.85 | 0.004 | 1.0105 | 1.016 | 0.0059 |
| 300 | 0.85 | 0.005 | 1.0119 | 1.012 | 0 |
| 300 | 0.85 | 0.006 | 1.013 | 1.05 | 0.037 |
| 300 | 0.85 | 0.007 | 1.0146 | 1.022 | 0.0077 |
| 300 | 0.85 | 0.008 | 1.0159 | 1.016 | 0 |
| 300 | 0.85 | 0.009 | 1.0169 | 1.071 | 0.0545 |
| 300 | 0.85 | 0.01 | 1.0184 | 1.03 | 0.0119 |
| 300 | 0.9 | 0.001 | 1.0064 | 1.009 | 0.0026 |
| 300 | 0.9 | 0.002 | 1.0075 | 2 | 0.9925 |
| 300 | 0.9 | 0.003 | 1.0099 | 1.016 | 0.0058 |
| 300 | 0.9 | 0.004 | 1.0112 | 1.011 | 0 |
| 300 | 0.9 | 0.005 | 1.0127 | 1.033 | 0.0206 |
| 300 | 0.9 | 0.006 | 1.0146 | 1.017 | 0.0021 |
| 300 | 0.9 | 0.007 | 1.0154 | 1.2 | 0.1846 |
| 300 | 0.9 | 0.008 | 1.017 | 1.033 | 0.0163 |
| 300 | 0.9 | 0.009 | 1.0187 | 1.02 | 0.0009 |
| 300 | 0.9 | 0.01 | 1.0195 | 1.125 | 0.1055 |
| 300 | 0.94 | 0.001 | 1.0071 | 1.007 | 0 |
| 300 | 0.94 | 0.002 | 1.009 | 1.018 | 0.0089 |
| 300 | 0.94 | 0.003 | 1.0108 | 1.011 | 0 |
| 300 | 0.94 | 0.004 | 1.0125 | 1.026 | 0.0138 |
| 300 | 0.94 | 0.005 | 1.0144 | 1.014 | 0 |
| 300 | 0.94 | 0.006 | 1.0155 | 1.053 | 0.0371 |
| 300 | 0.94 | 0.007 | 1.0175 | 1.021 | 0.0034 |
| 300 | 0.94 | 0.008 | 1.0183 | 1.333 | 0.315 |
| 300 | 0.94 | 0.009 | 1.0201 | 1.037 | 0.017 |
| 300 | 0.94 | 0.01 | 1.0217 | 1.022 | 0 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 300 | 0.95 | 0.001 | 1.0071 | 1.007 | 0 |
| 300 | 0.95 | 0.002 | 1.0096 | 1.014 | 0.0041 |
| 300 | 0.95 | 0.003 | 1.0107 | 1.017 | 0.0059 |
| 300 | 0.95 | 0.004 | 1.0132 | 1.019 | 0.0057 |
| 300 | 0.95 | 0.005 | 1.0142 | 1.014 | 0 |
| 300 | 0.95 | 0.006 | 1.0162 | 1.03 | 0.0141 |
| 300 | 0.95 | 0.007 | 1.0179 | 1.018 | 0 |
| 300 | 0.95 | 0.008 | 1.0191 | 1.059 | 0.0397 |
| 300 | 0.95 | 0.009 | 1.0209 | 1.025 | 0.0041 |
| 300 | 0.95 | 0.01 | 1.0218 | 1.333 | 0.3115 |
| 300 | 0.96 | 0.001 | 1.007 | 1.007 | 0 |
| 300 | 0.96 | 0.002 | 1.0103 | 1.011 | 0.0007 |
| 300 | 0.96 | 0.003 | 1.0114 | 1.05 | 0.0386 |
| 300 | 0.96 | 0.004 | 1.014 | 1.014 | 0.0003 |
| 300 | 0.96 | 0.005 | 1.0149 | 1.071 | 0.0566 |
| 300 | 0.96 | 0.006 | 1.0171 | 1.02 | 0.0033 |
| 300 | 0.96 | 0.007 | 1.018 | 1.25 | 0.232 |
| 300 | 0.96 | 0.008 | 1.02 | 1.031 | 0.0113 |
| 300 | 0.96 | 0.009 | 1.0213 | 1.021 | 0 |
| 300 | 0.96 | 0.01 | 1.0228 | 1.056 | 0.0327 |
| 300 | 0.97 | 0.001 | 1.0072 | 1.091 | 0.0837 |
| 300 | 0.97 | 0.002 | 1.0104 | 1.01 | 0 |
| 300 | 0.97 | 0.003 | 1.0123 | 1.023 | 0.0104 |
| 300 | 0.97 | 0.004 | 1.0139 | 1.014 | 0 |
| 300 | 0.97 | 0.005 | 1.016 | 1.028 | 0.0118 |
| 300 | 0.97 | 0.006 | 1.0175 | 1.017 | 0 |
| 300 | 0.97 | 0.007 | 1.0192 | 1.042 | 0.0225 |
| 300 | 0.97 | 0.008 | 1.0211 | 1.021 | 0 |
| 300 | 0.97 | 0.009 | 1.0221 | 1.077 | 0.0548 |
| 300 | 0.97 | 0.01 | 1.0242 | 1.028 | 0.0036 |
| 300 | 0.98 | 0.001 | 1.0083 | 1.02 | 0.0113 |
| 300 | 0.98 | 0.002 | 1.0103 | 1.01 | 0 |
| 300 | 0.98 | 0.003 | 1.0138 | 1.014 | 0 |
| 300 | 0.98 | 0.004 | 1.0149 | 1.05 | 0.0351 |
| 300 | 0.98 | 0.005 | 1.0173 | 1.017 | 0 |
| 300 | 0.98 | 0.006 | 1.0185 | 1.056 | 0.037 |
| 300 | 0.98 | 0.007 | 1.0208 | 1.021 | 0 |
| 300 | 0.98 | 0.008 | 1.0218 | 1.083 | 0.0615 |
| 300 | 0.98 | 0.009 | 1.024 | 1.027 | 0.003 |
| 300 | 0.98 | 0.01 | 1.0249 | 1.2 | 0.1751 |
| 300 | 0.99 | 0.001 | 1.0102 | 1.01 | 0 |
| 300 | 0.99 | 0.002 | 1.0125 | 1.019 | 0.0064 |
| 300 | 0.99 | 0.003 | 1.014 | 1.143 | 0.1288 |
| 300 | 0.99 | 0.004 | 1.0171 | 1.017 | 0 |
| 300 | 0.99 | 0.005 | 1.0186 | 1.045 | 0.0269 |
| 300 | 0.99 | 0.006 | 1.0206 | 1.021 | 0 |
| 300 | 0.99 | 0.007 | 1.0224 | 1.045 | 0.0231 |
| 300 | 0.99 | 0.008 | 1.0241 | 1.024 | 0 |
| 300 | 0.99 | 0.009 | 1.0258 | 1.056 | 0.0297 |
| 300 | 0.99 | 0.01 | 1.0277 | 1.028 | 0 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 400 | 0.75 | 0.001 | 1.0037 | 1.034 | 0.0308 |
| 400 | 0.75 | 0.002 | 1.0056 | 1.008 | 0.0027 |
| 400 | 0.75 | 0.003 | 1.0067 | 1.007 | 0 |
| 400 | 0.75 | 0.004 | 1.0082 | 1.019 | 0.0111 |
| 400 | 0.75 | 0.005 | 1.0096 | 1.011 | 0.0018 |
| 400 | 0.75 | 0.006 | 1.0106 | 1.083 | 0.0728 |
| 400 | 0.75 | 0.007 | 1.0119 | 1.023 | 0.0108 |
| 400 | 0.75 | 0.008 | 1.0132 | 1.015 | 0.0015 |
| 400 | 0.75 | 0.009 | 1.0142 | 1.077 | 0.0627 |
| 400 | 0.75 | 0.01 | 1.0154 | 1.028 | 0.0123 |
| 400 | 0.8 | 0.001 | 1.0041 | 1.014 | 0.0094 |
| 400 | 0.8 | 0.002 | 1.0062 | 1.006 | 0.0002 |
| 400 | 0.8 | 0.003 | 1.0071 | 1.027 | 0.0199 |
| 400 | 0.8 | 0.004 | 1.0087 | 1.011 | 0.0026 |
| 400 | 0.8 | 0.005 | 1.0097 | 1.125 | 0.1153 |
| 400 | 0.8 | 0.006 | 1.0112 | 1.021 | 0.0101 |
| 400 | 0.8 | 0.007 | 1.0126 | 1.013 | 0.0004 |
| 400 | 0.8 | 0.008 | 1.0136 | 1.05 | 0.0364 |
| 400 | 0.8 | 0.009 | 1.0149 | 1.022 | 0.0069 |
| 400 | 0.8 | 0.01 | 1.0159 | 1.016 | 0 |
| 400 | 0.85 | 0.001 | 1.0047 | 1.008 | 0.0035 |
| 400 | 0.85 | 0.002 | 1.006 | 2 | 0.994 |
| 400 | 0.85 | 0.003 | 1.0078 | 1.012 | 0.0044 |
| 400 | 0.85 | 0.004 | 1.0089 | 1.009 | 0 |
| 400 | 0.85 | 0.005 | 1.0105 | 1.02 | 0.0095 |
| 400 | 0.85 | 0.006 | 1.0119 | 1.012 | 0 |
| 400 | 0.85 | 0.007 | 1.013 | 1.036 | 0.0227 |
| 400 | 0.85 | 0.008 | 1.0144 | 1.017 | 0.0028 |
| 400 | 0.85 | 0.009 | 1.0154 | 1.1 | 0.0846 |
| 400 | 0.85 | 0.01 | 1.0168 | 1.027 | 0.0102 |
| 400 | 0.9 | 0.001 | 1.0056 | 1.006 | 0 |
| 400 | 0.9 | 0.002 | 1.0068 | 1.016 | 0.0091 |
| 400 | 0.9 | 0.003 | 1.0084 | 1.008 | 0 |
| 400 | 0.9 | 0.004 | 1.01 | 1.018 | 0.0082 |
| 400 | 0.9 | 0.005 | 1.0112 | 1.011 | 0 |
| 400 | 0.9 | 0.006 | 1.0127 | 1.024 | 0.0117 |
| 400 | 0.9 | 0.007 | 1.0141 | 1.014 | 0 |
| 400 | 0.9 | 0.008 | 1.0153 | 1.036 | 0.0204 |
| 400 | 0.9 | 0.009 | 1.0168 | 1.018 | 0.0007 |
| 400 | 0.9 | 0.01 | 1.0179 | 1.059 | 0.041 |
| 400 | 0.94 | 0.001 | 1.0053 | 1.005 | 0 |
| 400 | 0.94 | 0.002 | 1.008 | 1.008 | 0 |
| 400 | 0.94 | 0.003 | 1.0093 | 1.02 | 0.0107 |
| 400 | 0.94 | 0.004 | 1.0108 | 1.011 | 0 |
| 400 | 0.94 | 0.005 | 1.0125 | 1.019 | 0.0067 |
| 400 | 0.94 | 0.006 | 1.0137 | 1.25 | 0.2363 |
| 400 | 0.94 | 0.007 | 1.0154 | 1.022 | 0.0063 |
| 400 | 0.94 | 0.008 | 1.0165 | 1.2 | 0.1835 |
| 400 | 0.94 | 0.009 | 1.0182 | 1.026 | 0.0075 |
| 400 | 0.94 | 0.01 | 1.0192 | 1.25 | 0.2308 |
| 400 | 0.95 | 0.001 | 1.0055 | 1.091 | 0.0854 |
| 400 | 0.95 | 0.002 | 1.008 | 1.008 | 0 |
| 400 | 0.95 | 0.003 | 1.0098 | 1.014 | 0.0042 |
| 400 | 0.95 | 0.004 | 1.011 | 1.077 | 0.0659 |
| 400 | 0.95 | 0.005 | 1.0131 | 1.014 | 0.0012 |
| 400 | 0.95 | 0.006 | 1.0142 | 1.045 | 0.0313 |
| 400 | 0.95 | 0.007 | 1.016 | 1.016 | 0 |
| 400 | 0.95 | 0.008 | 1.0171 | 1.045 | 0.0284 |
| 400 | 0.95 | 0.009 | 1.0188 | 1.019 | 0 |
| 400 | 0.95 | 0.01 | 1.0199 | 1.05 | 0.0301 |
| 400 | 0.96 | 0.001 | 1.0059 | 1.023 | 0.0173 |
| 400 | 0.96 | 0.002 | 1.0079 | 1.008 | 0 |
| 400 | 0.96 | 0.003 | 1.0105 | 1.011 | 0.0003 |
| 400 | 0.96 | 0.004 | 1.0117 | 1.027 | 0.0153 |
| 400 | 0.96 | 0.005 | 1.0132 | 1.013 | 0 |
| 400 | 0.96 | 0.006 | 1.0149 | 1.023 | 0.0083 |
| 400 | 0.96 | 0.007 | 1.016 | 1.333 | 0.3173 |
| 400 | 0.96 | 0.008 | 1.0179 | 1.024 | 0.0059 |
| 400 | 0.96 | 0.009 | 1.019 | 1.143 | 0.1239 |
| 400 | 0.96 | 0.01 | 1.0207 | 1.026 | 0.0056 |
| 400 | 0.97 | 0.001 | 1.0065 | 1.013 | 0.0061 |
| 400 | 0.97 | 0.002 | 1.0085 | 1.033 | 0.0249 |
| 400 | 0.97 | 0.003 | 1.0104 | 1.01 | 0 |
| 400 | 0.97 | 0.004 | 1.0125 | 1.016 | 0.0031 |
| 400 | 0.97 | 0.005 | 1.0138 | 1.053 | 0.0389 |
| 400 | 0.97 | 0.006 | 1.0157 | 1.016 | 0 |
| 400 | 0.97 | 0.007 | 1.017 | 1.036 | 0.0187 |
| 400 | 0.97 | 0.008 | 1.0184 | 1.018 | 0 |
| 400 | 0.97 | 0.009 | 1.0201 | 1.032 | 0.0122 |
| 400 | 0.97 | 0.01 | 1.0212 | 2 | 0.9788 |
| 400 | 0.98 | 0.001 | 1.0075 | 1.008 | 0.0006 |
| 400 | 0.98 | 0.002 | 1.0095 | 1.014 | 0.0044 |
| 400 | 0.98 | 0.003 | 1.0111 | 1.037 | 0.0259 |
| 400 | 0.98 | 0.004 | 1.0129 | 1.013 | 0 |
| 400 | 0.98 | 0.005 | 1.015 | 1.019 | 0.0039 |
| 400 | 0.98 | 0.006 | 1.0163 | 1.063 | 0.0462 |
| 400 | 0.98 | 0.007 | 1.0182 | 1.018 | 0 |
| 400 | 0.98 | 0.008 | 1.0196 | 1.038 | 0.0189 |
| 400 | 0.98 | 0.009 | 1.0208 | 1.021 | 0 |
| 400 | 0.98 | 0.01 | 1.0227 | 1.033 | 0.0107 |
| 400 | 0.99 | 0.001 | 1.0076 | 1.008 | 0 |
| 400 | 0.99 | 0.002 | 1.0102 | 1.01 | 0 |
| 400 | 0.99 | 0.003 | 1.0128 | 1.013 | 0 |
| 400 | 0.99 | 0.004 | 1.0146 | 1.021 | 0.0067 |
| 400 | 0.99 | 0.005 | 1.016 | 1.071 | 0.0554 |
| 400 | 0.99 | 0.006 | 1.018 | 1.018 | 0 |
| 400 | 0.99 | 0.007 | 1.0198 | 1.029 | 0.0087 |
| 400 | 0.99 | 0.008 | 1.0211 | 1.143 | 0.1218 |
| 400 | 0.99 | 0.009 | 1.0233 | 1.023 | 0 |
| 400 | 0.99 | 0.01 | 1.0245 | 1.056 | 0.0311 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 500 | 0.75 | 0.001 | 1.0034 | 1.013 | 0.0094 |
| 500 | 0.75 | 0.002 | 1.0052 | 1.006 | 0.0004 |
| 500 | 0.75 | 0.003 | 1.0062 | 1.02 | 0.0134 |
| 500 | 0.75 | 0.004 | 1.0077 | 1.009 | 0.0013 |
| 500 | 0.75 | 0.005 | 1.0087 | 1.038 | 0.0298 |
| 500 | 0.75 | 0.006 | 1.01 | 1.014 | 0.0041 |
| 500 | 0.75 | 0.007 | 1.011 | 1.125 | 0.114 |
| 500 | 0.75 | 0.008 | 1.0123 | 1.022 | 0.0099 |
| 500 | 0.75 | 0.009 | 1.0135 | 1.014 | 0 |
| 500 | 0.75 | 0.01 | 1.0145 | 1.04 | 0.0255 |
| 500 | 0.8 | 0.001 | 1.0037 | 1.008 | 0.004 |
| 500 | 0.8 | 0.002 | 1.005 | 1.005 | 0 |
| 500 | 0.8 | 0.003 | 1.0067 | 1.01 | 0.0036 |
| 500 | 0.8 | 0.004 | 1.0078 | 1.1 | 0.0922 |
| 500 | 0.8 | 0.005 | 1.0092 | 1.014 | 0.0051 |
| 500 | 0.8 | 0.006 | 1.0103 | 1.2 | 0.1897 |
| 500 | 0.8 | 0.007 | 1.0116 | 1.02 | 0.0084 |
| 500 | 0.8 | 0.008 | 1.0127 | 1.013 | 0 |
| 500 | 0.8 | 0.009 | 1.0139 | 1.029 | 0.0146 |
| 500 | 0.8 | 0.01 | 1.0152 | 1.015 | 0.0002 |
| 500 | 0.85 | 0.001 | 1.0042 | 1.005 | 0.0012 |
| 500 | 0.85 | 0.002 | 1.0055 | 1.017 | 0.0111 |
| 500 | 0.85 | 0.003 | 1.0071 | 1.007 | 0 |
| 500 | 0.85 | 0.004 | 1.0084 | 1.016 | 0.0075 |
| 500 | 0.85 | 0.005 | 1.0095 | 1.01 | 0 |
| 500 | 0.85 | 0.006 | 1.011 | 1.018 | 0.0072 |
| 500 | 0.85 | 0.007 | 1.012 | 1.25 | 0.238 |
| 500 | 0.85 | 0.008 | 1.0134 | 1.022 | 0.0083 |
| 500 | 0.85 | 0.009 | 1.0145 | 1.25 | 0.2355 |
| 500 | 0.85 | 0.01 | 1.0158 | 1.026 | 0.0105 |
| 500 | 0.9 | 0.001 | 1.0045 | 1.004 | 0 |
| 500 | 0.9 | 0.002 | 1.0063 | 1.008 | 0.0014 |
| 500 | 0.9 | 0.003 | 1.0076 | 1.02 | 0.0124 |
| 500 | 0.9 | 0.004 | 1.009 | 1.009 | 0 |
| 500 | 0.9 | 0.005 | 1.0105 | 1.016 | 0.0054 |
| 500 | 0.9 | 0.006 | 1.0116 | 1.071 | 0.0598 |
| 500 | 0.9 | 0.007 | 1.0131 | 1.016 | 0.0027 |
| 500 | 0.9 | 0.008 | 1.0142 | 1.048 | 0.0334 |
| 500 | 0.9 | 0.009 | 1.0157 | 1.017 | 0.001 |
| 500 | 0.9 | 0.01 | 1.0167 | 1.042 | 0.0249 |
| 500 | 0.94 | 0.001 | 1.0048 | 1.022 | 0.017 |
| 500 | 0.94 | 0.002 | 1.0065 | 1.167 | 0.1601 |
| 500 | 0.94 | 0.003 | 1.0086 | 1.009 | 0 |
| 500 | 0.94 | 0.004 | 1.01 | 1.015 | 0.0054 |
| 500 | 0.94 | 0.005 | 1.0112 | 1.053 | 0.0414 |
| 500 | 0.94 | 0.006 | 1.0129 | 1.013 | 0 |
| 500 | 0.94 | 0.007 | 1.0142 | 1.026 | 0.0115 |
| 500 | 0.94 | 0.008 | 1.0153 | 1.2 | 0.1847 |
| 500 | 0.94 | 0.009 | 1.0169 | 1.021 | 0.0044 |
| 500 | 0.94 | 0.01 | 1.018 | 1.059 | 0.0408 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 500 | 0.95 | 0.001 | 1.0051 | 1.013 | 0.0079 |
| 500 | 0.95 | 0.002 | 1.0069 | 1.029 | 0.0225 |
| 500 | 0.95 | 0.003 | 1.0085 | 1.008 | 0 |
| 500 | 0.95 | 0.004 | 1.0105 | 1.011 | 0.0009 |
| 500 | 0.95 | 0.005 | 1.0117 | 1.024 | 0.0121 |
| 500 | 0.95 | 0.006 | 1.013 | 1.2 | 0.187 |
| 500 | 0.95 | 0.007 | 1.0147 | 1.017 | 0.0023 |
| 500 | 0.95 | 0.008 | 1.0158 | 1.04 | 0.0242 |
| 500 | 0.95 | 0.009 | 1.0171 | 1.017 | 0 |
| 500 | 0.95 | 0.01 | 1.0186 | 1.028 | 0.0092 |
| 500 | 0.96 | 0.001 | 1.0055 | 1.009 | 0.0035 |
| 500 | 0.96 | 0.002 | 1.0073 | 1.015 | 0.0078 |
| 500 | 0.96 | 0.003 | 1.0089 | 1.042 | 0.0328 |
| 500 | 0.96 | 0.004 | 1.0105 | 1.011 | 0 |
| 500 | 0.96 | 0.005 | 1.0123 | 1.015 | 0.0026 |
| 500 | 0.96 | 0.006 | 1.0135 | 1.033 | 0.0198 |
| 500 | 0.96 | 0.007 | 1.0148 | 1.015 | 0 |
| 500 | 0.96 | 0.008 | 1.0165 | 1.021 | 0.0043 |
| 500 | 0.96 | 0.009 | 1.0177 | 1.053 | 0.0349 |
| 500 | 0.96 | 0.01 | 1.0191 | 1.019 | 0 |
| 500 | 0.97 | 0.001 | 1.006 | 1.007 | 0.0006 |
| 500 | 0.97 | 0.002 | 1.0079 | 1.01 | 0.0018 |
| 500 | 0.97 | 0.003 | 1.0095 | 1.017 | 0.0071 |
| 500 | 0.97 | 0.004 | 1.011 | 1.043 | 0.0325 |
| 500 | 0.97 | 0.005 | 1.0125 | 1.013 | 0 |
| 500 | 0.97 | 0.006 | 1.0144 | 1.017 | 0.0023 |
| 500 | 0.97 | 0.007 | 1.0156 | 1.036 | 0.0201 |
| 500 | 0.97 | 0.008 | 1.0168 | 2 | 0.9832 |
| 500 | 0.97 | 0.009 | 1.0186 | 1.022 | 0.0031 |
| 500 | 0.97 | 0.01 | 1.0198 | 1.05 | 0.0302 |
| 500 | 0.98 | 0.001 | 1.0062 | 1.006 | 0 |
| 500 | 0.98 | 0.002 | 1.0082 | 1.008 | 0 |
| 500 | 0.98 | 0.003 | 1.0103 | 1.01 | 0 |
| 500 | 0.98 | 0.004 | 1.012 | 1.015 | 0.0029 |
| 500 | 0.98 | 0.005 | 1.0134 | 1.029 | 0.0152 |
| 500 | 0.98 | 0.006 | 1.0148 | 1.125 | 0.1102 |
| 500 | 0.98 | 0.007 | 1.0166 | 1.017 | 0 |
| 500 | 0.98 | 0.008 | 1.0181 | 1.026 | 0.0083 |
| 500 | 0.98 | 0.009 | 1.0193 | 1.071 | 0.0521 |
| 500 | 0.98 | 0.01 | 1.0208 | 1.021 | 0 |
| 500 | 0.99 | 0.001 | 1.0065 | 1.031 | 0.0247 |
| 500 | 0.99 | 0.002 | 1.0091 | 1.02 | 0.0109 |
| 500 | 0.99 | 0.003 | 1.011 | 1.028 | 0.0167 |
| 500 | 0.99 | 0.004 | 1.0128 | 1.056 | 0.0428 |
| 500 | 0.99 | 0.005 | 1.0143 | 1.014 | 0 |
| 500 | 0.99 | 0.006 | 1.0164 | 1.016 | 0 |
| 500 | 0.99 | 0.007 | 1.0181 | 1.023 | 0.0046 |
| 500 | 0.99 | 0.008 | 1.0194 | 1.045 | 0.026 |
| 500 | 0.99 | 0.009 | 1.0208 | 1.333 | 0.3125 |
| 500 | 0.99 | 0.01 | 1.0227 | 1.023 | 0 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 600 | 0.75 | 0.001 | 1.0031 | 1.008 | 0.0045 |
| 600 | 0.75 | 0.002 | 1.0045 | 1.004 | 0 |
| 600 | 0.75 | 0.003 | 1.0059 | 1.009 | 0.0034 |
| 600 | 0.75 | 0.004 | 1.007 | 1.056 | 0.0485 |
| 600 | 0.75 | 0.005 | 1.0083 | 1.012 | 0.0035 |
| 600 | 0.75 | 0.006 | 1.0094 | 1.053 | 0.0432 |
| 600 | 0.75 | 0.007 | 1.0106 | 1.014 | 0.0039 |
| 600 | 0.75 | 0.008 | 1.0117 | 1.063 | 0.0508 |
| 600 | 0.75 | 0.009 | 1.0129 | 1.018 | 0.005 |
| 600 | 0.75 | 0.01 | 1.014 | 1.077 | 0.063 |
| 600 | 0.8 | 0.001 | 1.0034 | 1.005 | 0.0019 |
| 600 | 0.8 | 0.002 | 1.0048 | 1.018 | 0.0131 |
| 600 | 0.8 | 0.003 | 1.0063 | 1.006 | 0 |
| 600 | 0.8 | 0.004 | 1.0074 | 1.014 | 0.0067 |
| 600 | 0.8 | 0.005 | 1.0085 | 1.167 | 0.1581 |
| 600 | 0.8 | 0.006 | 1.0099 | 1.014 | 0.0046 |
| 600 | 0.8 | 0.007 | 1.0109 | 1.059 | 0.0479 |
| 600 | 0.8 | 0.008 | 1.0122 | 1.016 | 0.0034 |
| 600 | 0.8 | 0.009 | 1.0133 | 1.048 | 0.0343 |
| 600 | 0.8 | 0.01 | 1.0145 | 1.017 | 0.0025 |
| 600 | 0.85 | 0.001 | 1.0039 | 1.004 | 9E-05 |
| 600 | 0.85 | 0.002 | 1.0052 | 1.008 | 0.0029 |
| 600 | 0.85 | 0.003 | 1.0065 | 1.024 | 0.0179 |
| 600 | 0.85 | 0.004 | 1.0079 | 1.008 | 0 |
| 600 | 0.85 | 0.005 | 1.0091 | 1.015 | 0.006 |
| 600 | 0.85 | 0.006 | 1.0102 | 1.063 | 0.0523 |
| 600 | 0.85 | 0.007 | 1.0116 | 1.014 | 0.0021 |
| 600 | 0.85 | 0.008 | 1.0127 | 1.033 | 0.0206 |
| 600 | 0.85 | 0.009 | 1.0139 | 1.014 | 0 |
| 600 | 0.85 | 0.01 | 1.0151 | 1.026 | 0.0112 |
| 600 | 0.9 | 0.001 | 1.0037 | 1.5 | 0.4963 |
| 600 | 0.9 | 0.002 | 1.0056 | 1.006 | 0 |
| 600 | 0.9 | 0.003 | 1.0072 | 1.008 | 0.0011 |
| 600 | 0.9 | 0.004 | 1.0084 | 1.016 | 0.008 |
| 600 | 0.9 | 0.005 | 1.0097 | 1.063 | 0.0528 |
| 600 | 0.9 | 0.006 | 1.0112 | 1.012 | 0.0005 |
| 600 | 0.9 | 0.007 | 1.0123 | 1.022 | 0.0094 |
| 600 | 0.9 | 0.008 | 1.0135 | 1.083 | 0.0699 |
| 600 | 0.9 | 0.009 | 1.0148 | 1.017 | 0.0018 |
| 600 | 0.9 | 0.01 | 1.016 | 1.033 | 0.0174 |
| 600 | 0.94 | 0.001 | 1.0045 | 1.009 | 0.0045 |
| 600 | 0.94 | 0.002 | 1.0062 | 1.013 | 0.007 |
| 600 | 0.94 | 0.003 | 1.0077 | 1.026 | 0.0186 |
| 600 | 0.94 | 0.004 | 1.0091 | 1.167 | 0.1576 |
| 600 | 0.94 | 0.005 | 1.0108 | 1.011 | 0 |
| 600 | 0.94 | 0.006 | 1.012 | 1.017 | 0.0052 |
| 600 | 0.94 | 0.007 | 1.0133 | 1.036 | 0.0225 |
| 600 | 0.94 | 0.008 | 1.0145 | 1.5 | 0.4855 |
| 600 | 0.94 | 0.009 | 1.016 | 1.019 | 0.0026 |
| 600 | 0.94 | 0.01 | 1.0171 | 1.036 | 0.0186 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 600 | 0.95 | 0.001 | 1.0048 | 1.007 | 0.0021 |
| 600 | 0.95 | 0.002 | 1.0065 | 1.009 | 0.0029 |
| 600 | 0.95 | 0.003 | 1.008 | 1.015 | 0.0069 |
| 600 | 0.95 | 0.004 | 1.0094 | 1.029 | 0.02 |
| 600 | 0.95 | 0.005 | 1.0108 | 1.167 | 0.1559 |
| 600 | 0.95 | 0.006 | 1.0124 | 1.012 | 0 |
| 600 | 0.95 | 0.007 | 1.0137 | 1.02 | 0.0059 |
| 600 | 0.95 | 0.008 | 1.0149 | 1.04 | 0.0251 |
| 600 | 0.95 | 0.009 | 1.0161 | 1.5 | 0.4839 |
| 600 | 0.95 | 0.01 | 1.0176 | 1.02 | 0.0024 |
| 600 | 0.96 | 0.001 | 1.0051 | 1.005 | 0.0003 |
| 600 | 0.96 | 0.002 | 1.0069 | 1.007 | 0.0002 |
| 600 | 0.96 | 0.003 | 1.0085 | 1.01 | 0.0016 |
| 600 | 0.96 | 0.004 | 1.0099 | 1.015 | 0.0055 |
| 600 | 0.96 | 0.005 | 1.0113 | 1.028 | 0.0165 |
| 600 | 0.96 | 0.006 | 1.0126 | 1.091 | 0.0783 |
| 600 | 0.96 | 0.007 | 1.0141 | 1.014 | 0 |
| 600 | 0.96 | 0.008 | 1.0155 | 1.02 | 0.0041 |
| 600 | 0.96 | 0.009 | 1.0167 | 1.036 | 0.019 |
| 600 | 0.96 | 0.01 | 1.018 | 1.125 | 0.107 |
| 600 | 0.97 | 0.001 | 1.0052 | 1.005 | 0 |
| 600 | 0.97 | 0.002 | 1.0069 | 1.007 | 0 |
| 600 | 0.97 | 0.003 | 1.0087 | 1.009 | 0 |
| 600 | 0.97 | 0.004 | 1.0104 | 1.01 | 0 |
| 600 | 0.97 | 0.005 | 1.0119 | 1.014 | 0.002 |
| 600 | 0.97 | 0.006 | 1.0133 | 1.022 | 0.0085 |
| 600 | 0.97 | 0.007 | 1.0146 | 1.042 | 0.0271 |
| 600 | 0.97 | 0.008 | 1.0159 | 1.2 | 0.1841 |
| 600 | 0.97 | 0.009 | 1.0175 | 1.017 | 0 |
| 600 | 0.97 | 0.01 | 1.0188 | 1.026 | 0.0076 |
| 600 | 0.98 | 0.001 | 1.0051 | 1.005 | 0 |
| 600 | 0.98 | 0.002 | 1.0074 | 1.025 | 0.0176 |
| 600 | 0.98 | 0.003 | 1.0092 | 1.027 | 0.0179 |
| 600 | 0.98 | 0.004 | 1.0108 | 1.042 | 0.0309 |
| 600 | 0.98 | 0.005 | 1.0123 | 1.1 | 0.0877 |
| 600 | 0.98 | 0.006 | 1.0138 | 1.014 | 0 |
| 600 | 0.98 | 0.007 | 1.0155 | 1.016 | 0 |
| 600 | 0.98 | 0.008 | 1.0169 | 1.021 | 0.0043 |
| 600 | 0.98 | 0.009 | 1.0182 | 1.034 | 0.0162 |
| 600 | 0.98 | 0.01 | 1.0195 | 1.077 | 0.0574 |
| 600 | 0.99 | 0.001 | 1.0062 | 1.009 | 0.0031 |
| 600 | 0.99 | 0.002 | 1.0085 | 1.008 | 0 |
| 600 | 0.99 | 0.003 | 1.0102 | 1.01 | 0 |
| 600 | 0.99 | 0.004 | 1.0119 | 1.012 | 0 |
| 600 | 0.99 | 0.005 | 1.0137 | 1.014 | 0 |
| 600 | 0.99 | 0.006 | 1.0154 | 1.015 | 0 |
| 600 | 0.99 | 0.007 | 1.0169 | 1.02 | 0.0031 |
| 600 | 0.99 | 0.008 | 1.0183 | 1.028 | 0.0095 |
| 600 | 0.99 | 0.009 | 1.0196 | 1.045 | 0.0258 |
| 600 | 0.99 | 0.01 | 1.021 | 1.1 | 0.079 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 700 | 0.75 | 0.001 | 1.003 | 1.005 | 0.0024 |
| 700 | 0.75 | 0.002 | 1.0042 | 1.02 | 0.0162 |
| 700 | 0.75 | 0.003 | 1.0056 | 1.006 | 0.0003 |
| 700 | 0.75 | 0.004 | 1.0068 | 1.013 | 0.0062 |
| 700 | 0.75 | 0.005 | 1.0079 | 1.091 | 0.0831 |
| 700 | 0.75 | 0.006 | 1.0091 | 1.013 | 0.0034 |
| 700 | 0.75 | 0.007 | 1.0102 | 1.037 | 0.0269 |
| 700 | 0.75 | 0.008 | 1.0114 | 1.013 | 0.0013 |
| 700 | 0.75 | 0.009 | 1.0124 | 1.029 | 0.0161 |
| 700 | 0.75 | 0.01 | 1.0135 | 1.014 | 0 |
| 700 | 0.8 | 0.001 | 1.0032 | 1.004 | 0.0008 |
| 700 | 0.8 | 0.002 | 1.0045 | 1.009 | 0.0042 |
| 700 | 0.8 | 0.003 | 1.0057 | 1.029 | 0.0237 |
| 700 | 0.8 | 0.004 | 1.0071 | 1.007 | 0.0003 |
| 700 | 0.8 | 0.005 | 1.0082 | 1.014 | 0.006 |
| 700 | 0.8 | 0.006 | 1.0094 | 1.05 | 0.0406 |
| 700 | 0.8 | 0.007 | 1.0106 | 1.012 | 0.0014 |
| 700 | 0.8 | 0.008 | 1.0117 | 1.025 | 0.0133 |
| 700 | 0.8 | 0.009 | 1.0128 | 1.2 | 0.1872 |
| 700 | 0.8 | 0.01 | 1.014 | 1.019 | 0.0052 |
| 700 | 0.85 | 0.001 | 1.0034 | 1.003 | 0 |
| 700 | 0.85 | 0.002 | 1.005 | 1.005 | 0.0004 |
| 700 | 0.85 | 0.003 | 1.0062 | 1.009 | 0.0032 |
| 700 | 0.85 | 0.004 | 1.0074 | 1.02 | 0.013 |
| 700 | 0.85 | 0.005 | 1.0086 | 1.167 | 0.1581 |
| 700 | 0.85 | 0.006 | 1.0099 | 1.012 | 0.0018 |
| 700 | 0.85 | 0.007 | 1.011 | 1.022 | 0.0112 |
| 700 | 0.85 | 0.008 | 1.0122 | 1.083 | 0.0712 |
| 700 | 0.85 | 0.009 | 1.0134 | 1.015 | 0.0017 |
| 700 | 0.85 | 0.01 | 1.0145 | 1.029 | 0.0141 |
| 700 | 0.9 | 0.001 | 1.0035 | 1.016 | 0.0123 |
| 700 | 0.9 | 0.002 | 1.0051 | 1.024 | 0.0187 |
| 700 | 0.9 | 0.003 | 1.0065 | 1.083 | 0.0768 |
| 700 | 0.9 | 0.004 | 1.008 | 1.008 | 0 |
| 700 | 0.9 | 0.005 | 1.0093 | 1.011 | 0.0019 |
| 700 | 0.9 | 0.006 | 1.0105 | 1.019 | 0.0083 |
| 700 | 0.9 | 0.007 | 1.0117 | 1.042 | 0.03 |
| 700 | 0.9 | 0.008 | 1.0129 | 1.023 | 0.0104 |
| 700 | 0.9 | 0.009 | 1.0142 | 1.017 | 0.0027 |
| 700 | 0.9 | 0.01 | 1.0154 | 1.029 | 0.0141 |
| 700 | 0.94 | 0.001 | 1.0042 | 1.005 | 0.0013 |
| 700 | 0.94 | 0.002 | 1.0059 | 1.007 | 0.0008 |
| 700 | 0.94 | 0.003 | 1.0074 | 1.009 | 0.0015 |
| 700 | 0.94 | 0.004 | 1.0088 | 1.012 | 0.0036 |
| 700 | 0.94 | 0.005 | 1.0101 | 1.018 | 0.0081 |
| 700 | 0.94 | 0.006 | 1.0113 | 1.031 | 0.0199 |
| 700 | 0.94 | 0.007 | 1.0126 | 1.077 | 0.0643 |
| 700 | 0.94 | 0.008 | 1.0139 | 1.014 | 0 |
| 700 | 0.94 | 0.009 | 1.0153 | 1.017 | 0.002 |
| 700 | 0.94 | 0.01 | 1.0164 | 1.026 | 0.0092 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 700 | 0.95 | 0.001 | 1.0045 | 1.005 | 8E-05 |
| 700 | 0.95 | 0.002 | 1.0061 | 1.006 | 0 |
| 700 | 0.95 | 0.003 | 1.0076 | 1.008 | 0 |
| 700 | 0.95 | 0.004 | 1.0091 | 1.009 | 0 |
| 700 | 0.95 | 0.005 | 1.0104 | 1.012 | 0.0016 |
| 700 | 0.95 | 0.006 | 1.0117 | 1.017 | 0.0049 |
| 700 | 0.95 | 0.007 | 1.013 | 1.025 | 0.012 |
| 700 | 0.95 | 0.008 | 1.0142 | 1.045 | 0.0312 |
| 700 | 0.95 | 0.009 | 1.0155 | 1.143 | 0.1274 |
| 700 | 0.95 | 0.01 | 1.0168 | 1.017 | 0 |
| 700 | 0.96 | 0.001 | 1.0045 | 1.004 | 0 |
| 700 | 0.96 | 0.002 | 1.006 | 1.009 | 0.0033 |
| 700 | 0.96 | 0.003 | 1.0076 | 1.1 | 0.0924 |
| 700 | 0.96 | 0.004 | 1.0091 | 1.167 | 0.1576 |
| 700 | 0.96 | 0.005 | 1.0105 | 1.011 | 0 |
| 700 | 0.96 | 0.006 | 1.012 | 1.012 | 0 |
| 700 | 0.96 | 0.007 | 1.0135 | 1.014 | 0.0008 |
| 700 | 0.96 | 0.008 | 1.0148 | 1.019 | 0.0045 |
| 700 | 0.96 | 0.009 | 1.016 | 1.028 | 0.0118 |
| 700 | 0.96 | 0.01 | 1.0172 | 1.045 | 0.0282 |
| 700 | 0.97 | 0.001 | 1.0044 | 1.004 | 0 |
| 700 | 0.97 | 0.002 | 1.0064 | 1.019 | 0.0128 |
| 700 | 0.97 | 0.003 | 1.0081 | 1.018 | 0.0094 |
| 700 | 0.97 | 0.004 | 1.0096 | 1.02 | 0.0104 |
| 700 | 0.97 | 0.005 | 1.0111 | 1.026 | 0.0146 |
| 700 | 0.97 | 0.006 | 1.0125 | 1.036 | 0.0233 |
| 700 | 0.97 | 0.007 | 1.0138 | 1.059 | 0.045 |
| 700 | 0.97 | 0.008 | 1.0151 | 1.143 | 0.1277 |
| 700 | 0.97 | 0.009 | 1.0165 | 1.016 | 0 |
| 700 | 0.97 | 0.01 | 1.018 | 1.018 | 0 |
| 700 | 0.98 | 0.001 | 1.0049 | 1.014 | 0.0094 |
| 700 | 0.98 | 0.002 | 1.0071 | 1.009 | 0.0015 |
| 700 | 0.98 | 0.003 | 1.0088 | 1.009 | 0 |
| 700 | 0.98 | 0.004 | 1.0103 | 1.01 | 0 |
| 700 | 0.98 | 0.005 | 1.0118 | 1.012 | 0 |
| 700 | 0.98 | 0.006 | 1.0133 | 1.013 | 0 |
| 700 | 0.98 | 0.007 | 1.0148 | 1.015 | 0.0004 |
| 700 | 0.98 | 0.008 | 1.0161 | 1.019 | 0.0024 |
| 700 | 0.98 | 0.009 | 1.0174 | 1.023 | 0.0058 |
| 700 | 0.98 | 0.01 | 1.0187 | 1.031 | 0.0125 |
| 700 | 0.99 | 0.001 | 1.0058 | 1.006 | 0 |
| 700 | 0.99 | 0.002 | 1.0074 | 1.067 | 0.0592 |
| 700 | 0.99 | 0.003 | 1.0094 | 1.02 | 0.0102 |
| 700 | 0.99 | 0.004 | 1.0112 | 1.016 | 0.0052 |
| 700 | 0.99 | 0.005 | 1.0129 | 1.016 | 0.0033 |
| 700 | 0.99 | 0.006 | 1.0144 | 1.017 | 0.0028 |
| 700 | 0.99 | 0.007 | 1.0159 | 1.019 | 0.003 |
| 700 | 0.99 | 0.008 | 1.0174 | 1.021 | 0.0039 |
| 700 | 0.99 | 0.009 | 1.0188 | 1.025 | 0.0062 |
| 700 | 0.99 | 0.01 | 1.0202 | 1.029 | 0.0093 |

| n | α | d | LB | UB | Gap |
|---|---|---|---|---|---|
| 800 | 0.75 | 0.001 | 1.0028 | 1.004 | 0.0013 |
| 800 | 0.75 | 0.002 | 1.0041 | 1.01 | 0.0055 |
| 800 | 0.75 | 0.003 | 1.0052 | 1.042 | 0.0364 |
| 800 | 0.75 | 0.004 | 1.0065 | 1.007 | 0.0008 |
| 800 | 0.75 | 0.005 | 1.0076 | 1.014 | 0.0062 |
| 800 | 0.75 | 0.006 | 1.0087 | 1.045 | 0.0367 |
| 800 | 0.75 | 0.007 | 1.0099 | 1.011 | 0.0012 |
| 800 | 0.75 | 0.008 | 1.011 | 1.021 | 0.0098 |
| 800 | 0.75 | 0.009 | 1.0121 | 1.083 | 0.0713 |
| 800 | 0.75 | 0.01 | 1.0132 | 1.016 | 0.0026 |
| 800 | 0.8 | 0.001 | 1.0031 | 1.003 | 0.0001 |
| 800 | 0.8 | 0.002 | 1.0043 | 1.006 | 0.0013 |
| 800 | 0.8 | 0.003 | 1.0055 | 1.011 | 0.005 |
| 800 | 0.8 | 0.004 | 1.0067 | 1.025 | 0.0183 |
| 800 | 0.8 | 0.005 | 1.0079 | 1.008 | 0 |
| 800 | 0.8 | 0.006 | 1.0091 | 1.012 | 0.0025 |
| 800 | 0.8 | 0.007 | 1.0102 | 1.022 | 0.0115 |
| 800 | 0.8 | 0.008 | 1.0113 | 1.071 | 0.0601 |
| 800 | 0.8 | 0.009 | 1.0125 | 1.014 | 0.0012 |
| 800 | 0.8 | 0.01 | 1.0136 | 1.023 | 0.0097 |
| 800 | 0.85 | 0.001 | 1.003 | 1.5 | 0.497 |
| 800 | 0.85 | 0.002 | 1.0044 | 1.004 | 0 |
| 800 | 0.85 | 0.003 | 1.0059 | 1.006 | 0 |
| 800 | 0.85 | 0.004 | 1.0072 | 1.009 | 0.0014 |
| 800 | 0.85 | 0.005 | 1.0083 | 1.014 | 0.0052 |
| 800 | 0.85 | 0.006 | 1.0095 | 1.024 | 0.0149 |
| 800 | 0.85 | 0.007 | 1.0106 | 1.077 | 0.0663 |
| 800 | 0.85 | 0.008 | 1.0119 | 1.012 | 0.0002 |
| 800 | 0.85 | 0.009 | 1.013 | 1.018 | 0.0048 |
| 800 | 0.85 | 0.01 | 1.0141 | 1.031 | 0.0171 |
| 800 | 0.9 | 0.001 | 1.0034 | 1.008 | 0.0045 |
| 800 | 0.9 | 0.002 | 1.005 | 1.009 | 0.0041 |
| 800 | 0.9 | 0.003 | 1.0063 | 1.012 | 0.0059 |
| 800 | 0.9 | 0.004 | 1.0076 | 1.018 | 0.0103 |
| 800 | 0.9 | 0.005 | 1.0088 | 1.029 | 0.0197 |
| 800 | 0.9 | 0.006 | 1.0101 | 1.063 | 0.0524 |
| 800 | 0.9 | 0.007 | 1.0113 | 1.02 | 0.0092 |
| 800 | 0.9 | 0.008 | 1.0126 | 1.013 | 0.0008 |
| 800 | 0.9 | 0.009 | 1.0137 | 1.018 | 0.0044 |
| 800 | 0.9 | 0.01 | 1.0149 | 1.027 | 0.0121 |
| 800 | 0.94 | 0.001 | 1.004 | 1.004 | 0 |
| 800 | 0.94 | 0.002 | 1.0053 | 1.005 | 0 |
| 800 | 0.94 | 0.003 | 1.0068 | 1.125 | 0.1182 |
| 800 | 0.94 | 0.004 | 1.0082 | 1.091 | 0.0827 |
| 800 | 0.94 | 0.005 | 1.0095 | 1.125 | 0.1155 |
| 800 | 0.94 | 0.006 | 1.0108 | 1.5 | 0.4892 |
| 800 | 0.94 | 0.007 | 1.0121 | 1.012 | 0 |
| 800 | 0.94 | 0.008 | 1.0135 | 1.013 | 0 |
| 800 | 0.94 | 0.009 | 1.0147 | 1.016 | 0.0017 |
| 800 | 0.94 | 0.01 | 1.0159 | 1.021 | 0.0049 |

| n | α | d | LB | UB | Gap |
|---|---|---|---|---|---|
| 800 | 0.95 | 0.001 | 1.004 | 1.004 | 0 |
| 800 | 0.95 | 0.002 | 1.0055 | 1.037 | 0.0315 |
| 800 | 0.95 | 0.003 | 1.0071 | 1.022 | 0.0152 |
| 800 | 0.95 | 0.004 | 1.0085 | 1.022 | 0.0137 |
| 800 | 0.95 | 0.005 | 1.0098 | 1.025 | 0.0152 |
| 800 | 0.95 | 0.006 | 1.0111 | 1.03 | 0.0192 |
| 800 | 0.95 | 0.007 | 1.0124 | 1.038 | 0.026 |
| 800 | 0.95 | 0.008 | 1.0137 | 1.056 | 0.0419 |
| 800 | 0.95 | 0.009 | 1.0149 | 1.091 | 0.076 |
| 800 | 0.95 | 0.01 | 1.0162 | 1.25 | 0.2338 |
| 800 | 0.96 | 0.001 | 1.0039 | 1.004 | 0 |
| 800 | 0.96 | 0.002 | 1.0058 | 1.014 | 0.0077 |
| 800 | 0.96 | 0.003 | 1.0074 | 1.011 | 0.0041 |
| 800 | 0.96 | 0.004 | 1.0089 | 1.012 | 0.003 |
| 800 | 0.96 | 0.005 | 1.0102 | 1.013 | 0.0027 |
| 800 | 0.96 | 0.006 | 1.0116 | 1.014 | 0.0029 |
| 800 | 0.96 | 0.007 | 1.0129 | 1.017 | 0.0038 |
| 800 | 0.96 | 0.008 | 1.0142 | 1.02 | 0.0054 |
| 800 | 0.96 | 0.009 | 1.0154 | 1.023 | 0.0078 |
| 800 | 0.96 | 0.01 | 1.0167 | 1.029 | 0.0119 |
| 800 | 0.97 | 0.001 | 1.0042 | 1.017 | 0.0125 |
| 800 | 0.97 | 0.002 | 1.0062 | 1.008 | 0.0016 |
| 800 | 0.97 | 0.003 | 1.0078 | 1.008 | 0 |
| 800 | 0.97 | 0.004 | 1.0091 | 1.009 | 0 |
| 800 | 0.97 | 0.005 | 1.0105 | 1.5 | 0.4895 |
| 800 | 0.97 | 0.006 | 1.0119 | 1.143 | 0.131 |
| 800 | 0.97 | 0.007 | 1.0132 | 1.125 | 0.1118 |
| 800 | 0.97 | 0.008 | 1.0145 | 1.143 | 0.1283 |
| 800 | 0.97 | 0.009 | 1.0158 | 1.2 | 0.1842 |
| 800 | 0.97 | 0.01 | 1.0171 | 1.5 | 0.4829 |
| 800 | 0.98 | 0.001 | 1.0047 | 1.007 | 0.0022 |
| 800 | 0.98 | 0.002 | 1.0064 | 1.006 | 0 |
| 800 | 0.98 | 0.003 | 1.0081 | 1.031 | 0.0232 |
| 800 | 0.98 | 0.004 | 1.0097 | 1.019 | 0.0092 |
| 800 | 0.98 | 0.005 | 1.0112 | 1.016 | 0.0052 |
| 800 | 0.98 | 0.006 | 1.0127 | 1.016 | 0.0032 |
| 800 | 0.98 | 0.007 | 1.014 | 1.016 | 0.0023 |
| 800 | 0.98 | 0.008 | 1.0154 | 1.017 | 0.0015 |
| 800 | 0.98 | 0.009 | 1.0168 | 1.018 | 0.0014 |
| 800 | 0.98 | 0.01 | 1.0181 | 1.02 | 0.0015 |
| 800 | 0.99 | 0.001 | 1.0051 | 1.005 | 0 |
| 800 | 0.99 | 0.002 | 1.0072 | 1.011 | 0.0033 |
| 800 | 0.99 | 0.003 | 1.0089 | 1.009 | 0 |
| 800 | 0.99 | 0.004 | 1.0104 | 1.067 | 0.0562 |
| 800 | 0.99 | 0.005 | 1.0121 | 1.028 | 0.0157 |
| 800 | 0.99 | 0.006 | 1.0136 | 1.021 | 0.0072 |
| 800 | 0.99 | 0.007 | 1.0152 | 1.019 | 0.0034 |
| 800 | 0.99 | 0.008 | 1.0166 | 1.018 | 0.0013 |
| 800 | 0.99 | 0.009 | 1.018 | 1.018 | 0 |
| 800 | 0.99 | 0.01 | 1.0193 | 1.019 | 0 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 900 | 0.75 | 0.001 | 1.0027 | 1.003 | 0.0007 |
| 900 | 0.75 | 0.002 | 1.0039 | 1.006 | 0.0023 |
| 900 | 0.75 | 0.003 | 1.0051 | 1.012 | 0.0069 |
| 900 | 0.75 | 0.004 | 1.0062 | 1.034 | 0.0282 |
| 900 | 0.75 | 0.005 | 1.0075 | 1.007 | 0 |
| 900 | 0.75 | 0.006 | 1.0085 | 1.012 | 0.0034 |
| 900 | 0.75 | 0.007 | 1.0096 | 1.022 | 0.0126 |
| 900 | 0.75 | 0.008 | 1.0107 | 1.071 | 0.0607 |
| 900 | 0.75 | 0.009 | 1.0119 | 1.013 | 0.0011 |
| 900 | 0.75 | 0.01 | 1.0129 | 1.021 | 0.0084 |
| 900 | 0.8 | 0.001 | 1.0028 | 1.003 | 0 |
| 900 | 0.8 | 0.002 | 1.0042 | 1.004 | 0 |
| 900 | 0.8 | 0.003 | 1.0054 | 1.006 | 0.0009 |
| 900 | 0.8 | 0.004 | 1.0065 | 1.01 | 0.0031 |
| 900 | 0.8 | 0.005 | 1.0077 | 1.016 | 0.0082 |
| 900 | 0.8 | 0.006 | 1.0088 | 1.031 | 0.0224 |
| 900 | 0.8 | 0.007 | 1.0099 | 1.167 | 0.1568 |
| 900 | 0.8 | 0.008 | 1.0111 | 1.012 | 0.0011 |
| 900 | 0.8 | 0.009 | 1.0122 | 1.018 | 0.006 |
| 900 | 0.8 | 0.01 | 1.0133 | 1.031 | 0.018 |
| 900 | 0.85 | 0.001 | 1.0028 | 1.017 | 0.0138 |
| 900 | 0.85 | 0.002 | 1.0043 | 1.016 | 0.0118 |
| 900 | 0.85 | 0.003 | 1.0056 | 1.023 | 0.0177 |
| 900 | 0.85 | 0.004 | 1.0068 | 1.042 | 0.0349 |
| 900 | 0.85 | 0.005 | 1.008 | 1.143 | 0.1349 |
| 900 | 0.85 | 0.006 | 1.0092 | 1.009 | 0 |
| 900 | 0.85 | 0.007 | 1.0104 | 1.012 | 0.0013 |
| 900 | 0.85 | 0.008 | 1.0115 | 1.016 | 0.0043 |
| 900 | 0.85 | 0.009 | 1.0127 | 1.023 | 0.0101 |
| 900 | 0.85 | 0.01 | 1.0138 | 1.036 | 0.0219 |
| 900 | 0.9 | 0.001 | 1.0033 | 1.005 | 0.0019 |
| 900 | 0.9 | 0.002 | 1.0048 | 1.006 | 0.0008 |
| 900 | 0.9 | 0.003 | 1.0061 | 1.006 | 0.0003 |
| 900 | 0.9 | 0.004 | 1.0074 | 1.008 | 0.0003 |
| 900 | 0.9 | 0.005 | 1.0086 | 1.009 | 0.0005 |
| 900 | 0.9 | 0.006 | 1.0098 | 1.011 | 0.0011 |
| 900 | 0.9 | 0.007 | 1.011 | 1.013 | 0.0023 |
| 900 | 0.9 | 0.008 | 1.0122 | 1.016 | 0.0039 |
| 900 | 0.9 | 0.009 | 1.0134 | 1.02 | 0.0066 |
| 900 | 0.9 | 0.01 | 1.0145 | 1.026 | 0.0111 |
| 900 | 0.94 | 0.001 | 1.0036 | 1.004 | 0 |
| 900 | 0.94 | 0.002 | 1.0051 | 1.018 | 0.0124 |
| 900 | 0.94 | 0.003 | 1.0066 | 1.012 | 0.0054 |
| 900 | 0.94 | 0.004 | 1.008 | 1.011 | 0.0034 |
| 900 | 0.94 | 0.005 | 1.0093 | 1.012 | 0.0023 |
| 900 | 0.94 | 0.006 | 1.0106 | 1.012 | 0.0018 |
| 900 | 0.94 | 0.007 | 1.0118 | 1.013 | 0.0015 |
| 900 | 0.94 | 0.008 | 1.0131 | 1.014 | 0.0014 |
| 900 | 0.94 | 0.009 | 1.0143 | 1.016 | 0.0016 |
| 900 | 0.94 | 0.01 | 1.0155 | 1.018 | 0.0021 |

| *n* | *α* | *d* | *LB* | *UB* | *Gap* |
|---|---|---|---|---|---|
| 900 | 0.95 | 0.001 | 1.0035 | 1.005 | 0.0019 |
| 900 | 0.95 | 0.002 | 1.0053 | 1.01 | 0.0047 |
| 900 | 0.95 | 0.003 | 1.0069 | 1.008 | 0.0014 |
| 900 | 0.95 | 0.004 | 1.0083 | 1.008 | 0 |
| 900 | 0.95 | 0.005 | 1.0094 | 1.009 | 0 |
| 900 | 0.95 | 0.006 | 1.0107 | 1.333 | 0.3226 |
| 900 | 0.95 | 0.007 | 1.012 | 1.111 | 0.0991 |
| 900 | 0.95 | 0.008 | 1.0132 | 1.083 | 0.0701 |
| 900 | 0.95 | 0.009 | 1.0145 | 1.077 | 0.0624 |
| 900 | 0.95 | 0.01 | 1.0157 | 1.077 | 0.0612 |
| 900 | 0.96 | 0.001 | 1.0038 | 1.016 | 0.0126 |
| 900 | 0.96 | 0.002 | 1.0056 | 1.007 | 0.0011 |
| 900 | 0.96 | 0.003 | 1.007 | 1.007 | 0 |
| 900 | 0.96 | 0.004 | 1.0083 | 1.059 | 0.0505 |
| 900 | 0.96 | 0.005 | 1.0097 | 1.029 | 0.0197 |
| 900 | 0.96 | 0.006 | 1.0111 | 1.023 | 0.0122 |
| 900 | 0.96 | 0.007 | 1.0124 | 1.021 | 0.0089 |
| 900 | 0.96 | 0.008 | 1.0137 | 1.021 | 0.0072 |
| 900 | 0.96 | 0.009 | 1.0149 | 1.021 | 0.0059 |
| 900 | 0.96 | 0.01 | 1.0162 | 1.021 | 0.0051 |
| 900 | 0.97 | 0.001 | 1.0041 | 1.008 | 0.0035 |
| 900 | 0.97 | 0.002 | 1.0058 | 1.006 | 0 |
| 900 | 0.97 | 0.003 | 1.0073 | 1.024 | 0.0171 |
| 900 | 0.97 | 0.004 | 1.0088 | 1.014 | 0.0055 |
| 900 | 0.97 | 0.005 | 1.0102 | 1.012 | 0.0018 |
| 900 | 0.97 | 0.006 | 1.0116 | 1.012 | 0 |
| 900 | 0.97 | 0.007 | 1.0128 | 1.013 | 0 |
| 900 | 0.97 | 0.008 | 1.0141 | 1.167 | 0.1526 |
| 900 | 0.97 | 0.009 | 1.0153 | 1.083 | 0.068 |
| 900 | 0.97 | 0.01 | 1.0166 | 1.063 | 0.0459 |
| 900 | 0.98 | 0.001 | 1.0046 | 1.005 | 0 |
| 900 | 0.98 | 0.002 | 1.0061 | 1.018 | 0.0121 |
| 900 | 0.98 | 0.003 | 1.0079 | 1.009 | 0.001 |
| 900 | 0.98 | 0.004 | 1.0092 | 1.009 | 0 |
| 900 | 0.98 | 0.005 | 1.0106 | 1.04 | 0.0294 |
| 900 | 0.98 | 0.006 | 1.0121 | 1.023 | 0.0106 |
| 900 | 0.98 | 0.007 | 1.0135 | 1.018 | 0.0047 |
| 900 | 0.98 | 0.008 | 1.0149 | 1.016 | 0.0013 |
| 900 | 0.98 | 0.009 | 1.0161 | 1.016 | 0 |
| 900 | 0.98 | 0.01 | 1.0173 | 1.017 | 0 |
| 900 | 0.99 | 0.001 | 1.0046 | 1.043 | 0.0388 |
| 900 | 0.99 | 0.002 | 1.0068 | 1.007 | 0 |
| 900 | 0.99 | 0.003 | 1.0084 | 1.019 | 0.0101 |
| 900 | 0.99 | 0.004 | 1.0102 | 1.01 | 0 |
| 900 | 0.99 | 0.005 | 1.0114 | 1.167 | 0.1552 |
| 900 | 0.99 | 0.006 | 1.013 | 1.029 | 0.0164 |
| 900 | 0.99 | 0.007 | 1.0145 | 1.019 | 0.0047 |
| 900 | 0.99 | 0.008 | 1.016 | 1.016 | 0 |
| 900 | 0.99 | 0.009 | 1.0171 | 1.017 | 0 |
| 900 | 0.99 | 0.01 | 1.0185 | 1.1 | 0.0815 |

| n | α | d | LB | UB | Gap |
|---|---|---|---|---|---|
| 1000 | 0.75 | 0.001 | 1.0026 | 1.003 | 0.0002 |
| 1000 | 0.75 | 0.002 | 1.0038 | 1.005 | 0.0007 |
| 1000 | 0.75 | 0.003 | 1.005 | 1.007 | 0.002 |
| 1000 | 0.75 | 0.004 | 1.0061 | 1.011 | 0.005 |
| 1000 | 0.75 | 0.005 | 1.0072 | 1.02 | 0.0124 |
| 1000 | 0.75 | 0.006 | 1.0083 | 1.048 | 0.0393 |
| 1000 | 0.75 | 0.007 | 1.0094 | 1.009 | 0 |
| 1000 | 0.75 | 0.008 | 1.0105 | 1.013 | 0.0023 |
| 1000 | 0.75 | 0.009 | 1.0116 | 1.019 | 0.0072 |
| 1000 | 0.75 | 0.01 | 1.0127 | 1.032 | 0.0196 |
| 1000 | 0.8 | 0.001 | 1.0025 | 1.003 | 0 |
| 1000 | 0.8 | 0.002 | 1.0039 | 1.05 | 0.0461 |
| 1000 | 0.8 | 0.003 | 1.0051 | 1.091 | 0.0858 |
| 1000 | 0.8 | 0.004 | 1.0063 | 1.006 | 0 |
| 1000 | 0.8 | 0.005 | 1.0075 | 1.008 | 0.0002 |
| 1000 | 0.8 | 0.006 | 1.0086 | 1.01 | 0.0015 |
| 1000 | 0.8 | 0.007 | 1.0097 | 1.014 | 0.0038 |
| 1000 | 0.8 | 0.008 | 1.0108 | 1.019 | 0.008 |
| 1000 | 0.8 | 0.009 | 1.0119 | 1.028 | 0.0158 |
| 1000 | 0.8 | 0.01 | 1.013 | 1.048 | 0.0346 |
| 1000 | 0.85 | 0.001 | 1.0028 | 1.008 | 0.0056 |
| 1000 | 0.85 | 0.002 | 1.0042 | 1.008 | 0.0037 |
| 1000 | 0.85 | 0.003 | 1.0054 | 1.009 | 0.0036 |
| 1000 | 0.85 | 0.004 | 1.0067 | 1.011 | 0.0041 |
| 1000 | 0.85 | 0.005 | 1.0078 | 1.013 | 0.0052 |
| 1000 | 0.85 | 0.006 | 1.009 | 1.016 | 0.0069 |
| 1000 | 0.85 | 0.007 | 1.0101 | 1.02 | 0.0095 |
| 1000 | 0.85 | 0.008 | 1.0113 | 1.025 | 0.0137 |
| 1000 | 0.85 | 0.009 | 1.0124 | 1.032 | 0.0199 |
| 1000 | 0.85 | 0.01 | 1.0135 | 1.045 | 0.032 |
| 1000 | 0.9 | 0.001 | 1.0031 | 1.004 | 0.0007 |
| 1000 | 0.9 | 0.002 | 1.0045 | 1.004 | 0 |
| 1000 | 0.9 | 0.003 | 1.0058 | 1.036 | 0.0299 |
| 1000 | 0.9 | 0.004 | 1.0071 | 1.023 | 0.0162 |
| 1000 | 0.9 | 0.005 | 1.0083 | 1.02 | 0.0121 |
| 1000 | 0.9 | 0.006 | 1.0095 | 1.02 | 0.0105 |
| 1000 | 0.9 | 0.007 | 1.0107 | 1.02 | 0.0097 |
| 1000 | 0.9 | 0.008 | 1.0119 | 1.022 | 0.0099 |
| 1000 | 0.9 | 0.009 | 1.013 | 1.023 | 0.0097 |
| 1000 | 0.9 | 0.01 | 1.0142 | 1.024 | 0.0102 |
| 1000 | 0.94 | 0.001 | 1.0033 | 1.077 | 0.0737 |
| 1000 | 0.94 | 0.002 | 1.005 | 1.008 | 0.0027 |
| 1000 | 0.94 | 0.003 | 1.0064 | 1.006 | 0 |
| 1000 | 0.94 | 0.004 | 1.0076 | 1.1 | 0.0924 |
| 1000 | 0.94 | 0.005 | 1.0089 | 1.029 | 0.0205 |
| 1000 | 0.94 | 0.006 | 1.0102 | 1.021 | 0.0106 |
| 1000 | 0.94 | 0.007 | 1.0115 | 1.018 | 0.0064 |
| 1000 | 0.94 | 0.008 | 1.0127 | 1.016 | 0.0037 |
| 1000 | 0.94 | 0.009 | 1.0139 | 1.016 | 0.002 |
| 1000 | 0.94 | 0.01 | 1.0151 | 1.015 | 0.0003 |

| n | α | d | LB | UB | Gap |
|---|---|---|---|---|---|
| 1000 | 0.95 | 0.001 | 1.0034 | 1.014 | 0.0111 |
| 1000 | 0.95 | 0.002 | 1.0052 | 1.006 | 0.0005 |
| 1000 | 0.95 | 0.003 | 1.0064 | 1.1 | 0.0936 |
| 1000 | 0.95 | 0.004 | 1.0079 | 1.02 | 0.0118 |
| 1000 | 0.95 | 0.005 | 1.0092 | 1.014 | 0.0047 |
| 1000 | 0.95 | 0.006 | 1.0105 | 1.012 | 0.0014 |
| 1000 | 0.95 | 0.007 | 1.0117 | 1.012 | 0 |
| 1000 | 0.95 | 0.008 | 1.0129 | 1.2 | 0.1871 |
| 1000 | 0.95 | 0.009 | 1.0141 | 1.067 | 0.0526 |
| 1000 | 0.95 | 0.01 | 1.0153 | 1.045 | 0.0301 |
| 1000 | 0.96 | 0.001 | 1.0036 | 1.008 | 0.0039 |
| 1000 | 0.96 | 0.002 | 1.0052 | 1.005 | 0 |
| 1000 | 0.96 | 0.003 | 1.0067 | 1.017 | 0.0099 |
| 1000 | 0.96 | 0.004 | 1.0082 | 1.01 | 0.0021 |
| 1000 | 0.96 | 0.005 | 1.0095 | 1.009 | 0 |
| 1000 | 0.96 | 0.006 | 1.0107 | 1.071 | 0.0607 |
| 1000 | 0.96 | 0.007 | 1.012 | 1.031 | 0.0192 |
| 1000 | 0.96 | 0.008 | 1.0133 | 1.023 | 0.0094 |
| 1000 | 0.96 | 0.009 | 1.0145 | 1.019 | 0.0047 |
| 1000 | 0.96 | 0.01 | 1.0158 | 1.017 | 0.0015 |
| 1000 | 0.97 | 0.001 | 1.004 | 1.005 | 0.0009 |
| 1000 | 0.97 | 0.002 | 1.0055 | 1.021 | 0.0158 |
| 1000 | 0.97 | 0.003 | 1.0071 | 1.008 | 0.0012 |
| 1000 | 0.97 | 0.004 | 1.0083 | 1.5 | 0.4917 |
| 1000 | 0.97 | 0.005 | 1.0098 | 1.024 | 0.0146 |
| 1000 | 0.97 | 0.006 | 1.0112 | 1.016 | 0.0045 |
| 1000 | 0.97 | 0.007 | 1.0125 | 1.013 | 0 |
| 1000 | 0.97 | 0.008 | 1.0136 | 1.333 | 0.3197 |
| 1000 | 0.97 | 0.009 | 1.0149 | 1.056 | 0.0406 |
| 1000 | 0.97 | 0.01 | 1.0162 | 1.034 | 0.0183 |
| 1000 | 0.98 | 0.001 | 1.0041 | 1.004 | 0 |
| 1000 | 0.98 | 0.002 | 1.006 | 1.007 | 0.0015 |
| 1000 | 0.98 | 0.003 | 1.0073 | 1.059 | 0.0515 |
| 1000 | 0.98 | 0.004 | 1.0089 | 1.013 | 0.0042 |
| 1000 | 0.98 | 0.005 | 1.0103 | 1.01 | 0 |
| 1000 | 0.98 | 0.006 | 1.0116 | 1.045 | 0.0338 |
| 1000 | 0.98 | 0.007 | 1.013 | 1.022 | 0.0087 |
| 1000 | 0.98 | 0.008 | 1.0144 | 1.016 | 0.0012 |
| 1000 | 0.98 | 0.009 | 1.0155 | 1.016 | 0 |
| 1000 | 0.98 | 0.01 | 1.0169 | 1.071 | 0.0546 |
| 1000 | 0.99 | 0.001 | 1.0045 | 1.01 | 0.0055 |
| 1000 | 0.99 | 0.002 | 1.0063 | 1.028 | 0.0214 |
| 1000 | 0.99 | 0.003 | 1.0081 | 1.008 | 0 |
| 1000 | 0.99 | 0.004 | 1.0096 | 1.022 | 0.0126 |
| 1000 | 0.99 | 0.005 | 1.0112 | 1.011 | 0 |
| 1000 | 0.99 | 0.006 | 1.0125 | 1.059 | 0.0463 |
| 1000 | 0.99 | 0.007 | 1.014 | 1.021 | 0.0068 |
| 1000 | 0.99 | 0.008 | 1.0154 | 1.015 | 0 |
| 1000 | 0.99 | 0.009 | 1.0166 | 1.083 | 0.0667 |
| 1000 | 0.99 | 0.01 | 1.018 | 1.033 | 0.0153 |

## Appendix G – Conditions where Sharing is more beneficial than No-Sharing

Sharing is beneficial with respect to service if $u(1,1)_{sharing} \geq u(1,1)_{no-sharing}$. This can be rewritten as a function of $d_0$ as follows.

$$
\begin{aligned}
&\left(2(d_1+\mu)\left(d_1\mu+(\bar{\lambda}+\mu)^2\right)\right)d_0^2 \\
&+\left(\begin{aligned}
&2(d_1+2d_2)\mu^3+\left(4d_1^2+10d_1d_2-2d_1\bar{\lambda}+6d_2\bar{\lambda}-\bar{\lambda}^2\right)\mu^2 \\
&+d_1(d_1+3d_2-2\bar{\lambda})\bar{\lambda}^2+\left(6d_1^2d_2+2d_1(d_1+3d_2)\bar{\lambda}-3(d_1-d_2)\bar{\lambda}^2-\bar{\lambda}^3\right)\mu \\
&+2d_{-1}(d_1+\mu)\left(d_1\mu+(\bar{\lambda}+\mu)^2\right)
\end{aligned}\right)d_0 \\
&+\left(\begin{aligned}
&2\left(d_{-1}d_2+(d_1+d_2)(d_1+d_2-\bar{\lambda})\right)\mu^3 \\
&+2\left(d_1(3d_2(d_1+d_2)+d_{-1}(d_1+3d_2))-(d_1-d_2)(d_{-1}-d_1+d_2)\bar{\lambda}-(d_1+d_2)\bar{\lambda}^2\right)\mu^2 \\
&+\left(\begin{aligned}
&4d_1^2d_2(d_{-1}+d_2)+2d_1(d_{-1}+d_2)(d_1+d_2)\bar{\lambda} \\
&+\left(d_1^2-4d_1d_2+d_2^2+d_{-1}(-2d_1+d_2)\right)\bar{\lambda}^2-(d_1+d_2)\bar{\lambda}^3
\end{aligned}\right)\mu \\
&+d_1\bar{\lambda}^2\left((d_{-1}+d_2)(d_1+d_2)-(d_{-1}+2d_2)\bar{\lambda}\right)
\end{aligned}\right)\geq 0
\end{aligned}
$$

Similarly, sharing is beneficial with respect to cost only when $z(1,1)_{sharing} \leq z(1,1)_{no-sharing}$. This can be rewritten as a function of $\mu$ as follows.

$$
\begin{aligned}
&2\left(\begin{array}{l}
2d_{-1}^{2}c^{out}+d_{1}^{2}\left(c^{in}+c^{out}\right)+\left(d_{0}+d_{2}\right)\left(2d_{0}c^{in}+d_{2}\left(c^{in}+c^{out}\right)\right)+2d_{1}\left(d_{0}+d_{2}\right)\left(c^{in}+c^{e}\right)\\
+d_{-1}\left(d_{2}c^{in}+3d_{2}c^{out}+2d_{0}\left(c^{in}+c^{out}\right)+d_{1}\left(c^{in}+c^{out}+2c^{e}\right)-c^{out}\overline{\lambda}+c^{e}\overline{\lambda}\right)\\
-d_{1}\left(c^{in}-c^{e}\right)\overline{\lambda}-\left(d_{0}+d_{2}\right)\left(c^{in}-c^{e}\right)\overline{\lambda}-2c^{e}\overline{\lambda}^{2}
\end{array}\right)\mu^{3}\\
&+\left(\begin{array}{l}
2d_{-1}^{3}c^{out}+2\left(d_{1}+d_{2}+d_{0}\right)\left(\left(3d_{1}+d_{0}\right)\left(d_{0}+d_{2}\right)c^{in}+\left(d_{1}^{2}+d_{2}\left(d_{0}+d_{2}\right)\right)c^{out}\right)\\
+2\left(\left(d_{0}+d_{2}-d_{1}\right)^{2}c^{in}+3d_{1}\left(d_{0}+d_{2}\right)c^{e}\right)\overline{\lambda}\\
-\left(2d_{1}c^{in}+d_{0}c^{in}+2d_{2}c^{in}-d_{1}c^{out}-d_{2}c^{out}+\left(d_{1}+d_{2}+d_{0}\right)c^{e}\right)\overline{\lambda}^{2}\\
-2c^{e}\overline{\lambda}^{3}+2d_{-1}^{2}\left(d_{0}c^{in}+2d_{0}c^{out}+3d_{2}c^{out}+d_{1}\left(c^{in}+3c^{out}\right)+c^{out}\overline{\lambda}\right)\\
+d_{-1}\left(\begin{array}{l}
4d_{1}^{2}\left(c^{in}+c^{out}\right)+2\left(d_{0}+d_{2}\right)\left(3d_{2}c^{out}+d_{0}\left(2c^{in}+c^{out}\right)\right)+2\left(d_{0}+d_{2}\right)\left(c^{in}+c^{out}\right)\overline{\lambda}\\
-\left(c^{out}+c^{e}\right)\overline{\lambda}^{2}+2d_{1}\left(4d_{2}\left(c^{in}+c^{out}\right)+d_{0}\left(5c^{in}+3c^{out}\right)-\left(c^{in}+c^{out}-3c^{e}\right)\overline{\lambda}\right)
\end{array}\right)
\end{array}\right)\mu^{2}\\
&+\left(\begin{array}{l}
2d_{1}\left(d_{-1}+d_{0}+d_{2}\right)\left(\begin{array}{l}
\left(3d_{1}+d_{0}\right)\left(d_{0}+d_{2}\right)c^{in}+\left(d_{1}^{2}+d_{2}\left(d_{0}+d_{2}\right)\right)c^{in}\\
+\left(d_{-1}^{2}+d_{1}^{2}+d_{2}\left(d_{0}+d_{2}\right)+d_{-1}\left(d_{1}+d_{0}+2d_{2}\right)\right)c^{out}\\
+\left(\left(d_{1}+d_{0}+d_{2}\right)c^{in}+d_{-1}c^{out}\right)\overline{\lambda}
\end{array}\right)\\
+\left(\begin{array}{l}
2d_{-1}^{2}c^{out}+d_{1}^{2}\left(c^{in}+c^{out}\right)+\left(d_{0}+d_{2}\right)\left(2d_{0}c^{in}+d_{2}\left(c^{in}+c^{out}\right)\right)+d_{-1}\left(\begin{array}{l}
2d_{0}\left(c^{in}+c^{out}\right)\\
+d_{2}\left(c^{in}+3c^{out}\right)\\
-2d_{1}\left(c^{in}-c^{e}\right)
\end{array}\right)\\
+d_{1}\left(2d_{2}\left(c^{out}-2c^{in}+c^{e}\right)+d_{0}\left(c^{out}-3c^{in}+2c^{e}\right)\right)
\end{array}\right)\overline{\lambda}^{2}\\
-\left(\left(d_{1}+d_{0}+d_{2}\right)\left(c^{in}+c^{e}\right)+d_{-1}\left(c^{out}+c^{e}\right)\right)\overline{\lambda}^{3}
\end{array}\right)\mu\\
&+d_{1}\overline{\lambda}^{2}\left(\begin{array}{l}
\left(d_{-1}+d_{0}+d_{2}\right)\left(\left(d_{1}+2d_{0}+d_{2}\right)c^{in}+\left(2d_{-1}+d_{1}+d_{2}\right)c^{out}\right)\\
-\left(2\left(d_{0}+d_{2}\right)c^{in}+d_{-1}\left(c^{in}+c^{out}\right)\right)\overline{\lambda}
\end{array}\right)\leq 0
\end{aligned}
$$

# Appendix H – DOE Results for Multiple Pool Problem

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 0 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0 | Opt | 0.421 | 0 | 0.01 | 0 |
| 0 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 0 | Opt | 0.03 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0 | Opt | 0.04 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0 | Opt | 0.03 | 0 | 0.01 | 0 |
| 0 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0 | Opt | 0.03 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 0 | Opt | 0.03 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0 | Opt | 0.03 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0 | Opt | 0.04 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0 | Opt | 0.04 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0 | Opt | 0.031 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0 | Opt | 0.03 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0 | Opt | 0.02 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0 | Opt | 0.03 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0 | Opt | 0.02 | 0 | 0.01 | 0 |
| 0 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.0247 | Opt | 0.02 | 0.2876 | 0.01 | 10.665 |
| 0 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 0.0331 | Opt | 0.02 | 0.1411 | 0.01 | 3.2619 |
| 0 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.0775 | Opt | 0.02 | 0.9584 | 0.01 | 11.367 |
| 0 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0.0952 | Opt | 0.03 | 0.6472 | 0 | 5.7965 |
| 0 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.2045 | Opt | 0.03 | 0.8099 | 0.01 | 2.9613 |
| 0 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 0.2364 | Opt | 0.02 | 0.6806 | 0.01 | 1.8792 |
| 0 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.3719 | Opt | 0.03 | 1.4434 | 0 | 2.8811 |
| 0 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0.4182 | Opt | 0.03 | 1.2908 | 0 | 2.0866 |
| 0 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.0247 | Opt | 0.03 | 0.0992 | 0 | 3.022 |
| 0 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.0775 | Opt | 0.02 | 0.3892 | 0.01 | 4.0226 |
| 0 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0.0952 | Opt | 0.03 | 0.1336 | 0 | 0.4034 |
| 0 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.2045 | Opt | 0.03 | 0.3557 | 0 | 0.7396 |
| 0 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.3719 | Opt | 0.03 | 0.6994 | 0 | 0.8805 |
| 0 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0.4182 | Opt | 0.03 | 0.4182 | 0 | 0 |
| 0 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.0493 | Opt | 0.03 | 0.5752 | 0 | 10.665 |
| 0 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 0.0662 | Opt | 0.03 | 0.2823 | 0 | 3.2619 |
| 0 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.155 | Opt | 0.031 | 1.9168 | 0 | 11.367 |
| 0 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0.1905 | Opt | 0.04 | 1.2944 | 0 | 5.7965 |
| 0 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.4089 | Opt | 0.08 | 1.6199 | 0.01 | 2.9613 |
| 0 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 0.4728 | Opt | 0.33 | 1.3612 | 0 | 1.8792 |
| 0 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.7438 | Opt | 0.03 | 2.8868 | 0 | 2.8811 |
| 0 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0.8364 | Opt | 0.03 | 2.5815 | 0.01 | 2.0866 |
| 0 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.0493 | Opt | 0.03 | 0.1983 | 0 | 3.0219 |
| 0 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.155 | Opt | 0.03 | 0.7785 | 0.01 | 4.0225 |
| 0 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0.1905 | Opt | 0.02 | 0.2673 | 0.01 | 0.4034 |
| 0 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.4089 | Opt | 0.03 | 0.7114 | 0 | 0.7396 |
| 0 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.7438 | Opt | 0.031 | 1.3988 | 0 | 0.8805 |
| 0 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0.8364 | Opt | 0.03 | 0.8364 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 0 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 11 | 1 | 38 | 0.2286 | Opt | 0.29 | 0.7663 | 0 | 2.352 |
| 0 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 6 | 2 | 42 | 0.739 | Opt | 0.17 | 0.9597 | 0 | 0.2986 |
| 0 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 11 | 1 | 38 | 0.2492 | Opt | 0.531 | 0.8802 | 0 | 2.5323 |
| 0 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 8 | 1 | 41 | 0.7195 | Opt | 0.05 | 1.0995 | 0 | 0.5283 |
| 0 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 8 | 0 | 42 | 0.646 | Opt | 0.04 | 1.5982 | 0 | 1.4741 |
| 0 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 6 | 0 | 44 | 1.1663 | Opt | 0.12 | 1.7888 | 0 | 0.5338 |
| 0 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 8 | 0 | 42 | 0.7271 | Opt | 0.201 | 1.7105 | 0.01 | 1.3526 |
| 0 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 6 | 0 | 44 | 1.2334 | Opt | 0.47 | 1.9336 | 0 | 0.5677 |
| 0 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 1 | 44 | 0.2882 | Opt | 0.121 | 0.4672 | 0 | 0.6208 |
| 0 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 5 | 1 | 44 | 0.3112 | Opt | 0.14 | 0.5411 | 0 | 0.739 |
| 0 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 1 | 0 | 49 | 0.8626 | Opt | 0.03 | 0.8782 | 0.01 | 0.0182 |
| 0 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 0 | 47 | 0.7702 | Opt | 0.21 | 1.0437 | 0 | 0.3552 |
| 0 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 3 | 0 | 47 | 0.862 | Opt | 0.291 | 1.1285 | 0 | 0.3092 |
| 0 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1.4373 | Opt | 0.03 | 1.4373 | 0 | 0 |
| 0 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.3646 | Opt | 0.04 | 1.1233 | 0 | 2.0805 |
| 0 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 0.8873 | Opt | 0.04 | 1.183 | 0.01 | 0.3332 |
| 0 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.448 | Opt | 0.03 | 1.9258 | 0 | 3.2985 |
| 0 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0.9772 | Opt | 0.04 | 1.9039 | 0 | 0.9483 |
| 0 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 1.0268 | Opt | 0.04 | 2.5229 | 0 | 1.457 |
| 0 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 1.5824 | Opt | 0.03 | 2.6266 | 0.01 | 0.6599 |
| 0 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 1.2912 | Opt | 0.03 | 3.2832 | 0 | 1.5427 |
| 0 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1.8555 | Opt | 0.04 | 3.321 | 0 | 0.7898 |
| 0 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.3646 | Opt | 0.03 | 0.65 | 0.01 | 0.7825 |
| 0 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 0 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.448 | Opt | 0.03 | 1.0805 | 0 | 1.4117 |
| 0 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 0.9772 | Opt | 0.04 | 1.0564 | 0 | 0.081 |
| 0 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 1.0268 | Opt | 0.03 | 1.4379 | 0 | 0.4003 |
| 0 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 1.2912 | Opt | 0.07 | 1.9329 | 0 | 0.497 |
| 0 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1.8555 | Opt | 0.04 | 1.8555 | 0 | 0 |
| 0 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.3893 | Opt | 0.051 | 1.3904 | 0 | 2.5716 |
| 0 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 0.9205 | Opt | 0.05 | 1.3364 | 0 | 0.4519 |
| 0 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.5255 | Opt | 0.04 | 2.8803 | 0 | 4.481 |
| 0 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1.0724 | Opt | 0.06 | 2.5777 | 0 | 1.4036 |
| 0 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 1.2313 | Opt | 0.03 | 3.3253 | 0.01 | 1.7007 |
| 0 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 1.8188 | Opt | 0.1 | 3.2748 | 0 | 0.8005 |
| 0 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 1.6631 | Opt | 0.06 | 4.7099 | 0.01 | 1.832 |
| 0 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 2.2737 | Opt | 0.08 | 4.6821 | 0 | 1.0593 |
| 0 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.3893 | Opt | 0.15 | 0.7329 | 0 | 0.8825 |
| 0 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.5255 | Opt | 0.071 | 1.4697 | 0.01 | 1.7967 |
| 0 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1.0724 | Opt | 0.06 | 1.19 | 0 | 0.1096 |
| 0 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 1.2313 | Opt | 0.03 | 1.7935 | 0 | 0.4566 |
| 0 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 1.6631 | Opt | 0.05 | 2.6323 | 0.01 | 0.5827 |
| 0 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 2.2737 | Opt | 0.03 | 2.2737 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 0 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 11 | 1 | 38 | 0.4572 | Opt | 0.28 | 1.5326 | 0 | 2.352 |
| 0 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 6 | 2 | 42 | 1.478 | Opt | 0.291 | 1.9194 | 0 | 0.2986 |
| 0 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 11 | 1 | 38 | 0.4984 | Opt | 0.32 | 1.7603 | 0 | 2.5323 |
| 0 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 8 | 1 | 41 | 1.4389 | Opt | 0.09 | 2.199 | 0 | 0.5283 |
| 0 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 8 | 0 | 42 | 1.292 | Opt | 0.07 | 3.1965 | 0 | 1.4741 |
| 0 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 6 | 0 | 44 | 2.3325 | Opt | 0.191 | 3.5777 | 0.01 | 0.5338 |
| 0 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 8 | 0 | 42 | 1.4541 | Opt | 0.41 | 3.421 | 0 | 1.3526 |
| 0 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 6 | 0 | 44 | 2.4667 | Opt | 0.611 | 3.8672 | 0 | 0.5677 |
| 0 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 1 | 44 | 0.5765 | Opt | 0.16 | 0.9344 | 0 | 0.6208 |
| 0 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 5 | 1 | 44 | 0.6223 | Opt | 0.161 | 1.0823 | 0.01 | 0.7391 |
| 0 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 1 | 0 | 49 | 1.7252 | Opt | 0.03 | 1.7565 | 0.01 | 0.0181 |
| 0 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 0 | 47 | 1.5403 | Opt | 0.23 | 2.0874 | 0 | 0.3552 |
| 0 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 3 | 0 | 47 | 1.724 | Opt | 0.34 | 2.2571 | 0 | 0.3092 |
| 0 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 2.8746 | Opt | 0.041 | 2.8746 | 0 | 0 |
| 0 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.7046 | Opt | 0.05 | 1.8996 | 0 | 1.6958 |
| 0 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 1.7416 | Opt | 0.04 | 2.2117 | 0 | 0.2699 |
| 0 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.8185 | Opt | 0.03 | 2.8095 | 0 | 2.4323 |
| 0 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1.8592 | Opt | 0.04 | 3.137 | 0 | 0.6873 |
| 0 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 1.8492 | Opt | 0.04 | 4.1819 | 0 | 1.2615 |
| 0 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 2.9284 | Opt | 0.03 | 4.4738 | 0.01 | 0.5277 |
| 0 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 2.2105 | Opt | 0.03 | 5.0132 | 0 | 1.2679 |
| 0 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 3.2928 | Opt | 0.03 | 5.383 | 0.01 | 0.6348 |
| 0 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.7046 | Opt | 0.03 | 1.1143 | 0 | 0.5814 |
| 0 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.8185 | Opt | 0.03 | 1.6669 | 0.01 | 1.0365 |
| 0 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1.8592 | Opt | 0.03 | 1.9719 | 0 | 0.0606 |
| 0 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 1.8492 | Opt | 0.04 | 2.467 | 0 | 0.3341 |
| 0 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 2.2105 | Opt | 0.03 | 3.1283 | 0 | 0.4152 |
| 0 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 3.2928 | Opt | 0.03 | 3.2928 | 0.01 | 0 |
| 0 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.7293 | Opt | 0.03 | 2.2466 | 0 | 2.0805 |
| 0 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 1.7747 | Opt | 0.03 | 2.3659 | 0.01 | 0.3332 |
| 0 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.896 | Opt | 0.03 | 3.8516 | 0 | 3.2986 |
| 0 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1.9544 | Opt | 0.041 | 3.8079 | 0 | 0.9483 |
| 0 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 2.0537 | Opt | 0.03 | 5.0459 | 0 | 1.457 |
| 0 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 3.1648 | Opt | 0.03 | 5.2531 | 0 | 0.6599 |
| 0 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 2.5824 | Opt | 0.03 | 6.5663 | 0 | 1.5427 |
| 0 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 3.711 | Opt | 0.03 | 6.6419 | 0 | 0.7898 |
| 0 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 0.7293 | Opt | 0.03 | 1.3 | 0 | 0.7825 |
| 0 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 0.896 | Opt | 0.04 | 2.1609 | 0 | 1.4117 |
| 0 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1.9544 | Opt | 0.03 | 2.1127 | 0 | 0.081 |
| 0 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 2.0537 | Opt | 0.04 | 2.8757 | 0 | 0.4003 |
| 0 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 2.5824 | Opt | 0.03 | 3.8658 | 0 | 0.497 |
| 0 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 3.711 | Opt | 0.08 | 3.711 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 0 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 11 | 2 | 37 | 1.8042 | Opt | 0.17 | 2.3446 | 0.01 | 0.2995 |
| 0 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 6 | 2 | 42 | 2.5124 | Opt | 0.171 | 2.7447 | 0 | 0.0925 |
| 0 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 11 | 2 | 37 | 2.6709 | Opt | 0.26 | 3.3165 | 0 | 0.2417 |
| 0 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 8 | 1 | 41 | 3.3387 | Opt | 0.11 | 3.7336 | 0 | 0.1183 |
| 0 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 8 | 0 | 42 | 4.1099 | Opt | 0.341 | 5.0625 | 0 | 0.2318 |
| 0 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 6 | 0 | 44 | 4.8326 | Opt | 0.13 | 5.4902 | 0 | 0.1361 |
| 0 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 8 | 0 | 42 | 5.0347 | Opt | 0.39 | 6.0231 | 0 | 0.1963 |
| 0 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 6 | 0 | 44 | 5.7438 | Opt | 1.232 | 6.4773 | 0 | 0.1277 |
| 0 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 2 | 43 | 2.0752 | Opt | 0.18 | 2.2624 | 0.01 | 0.0902 |
| 0 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0.01 | 0 |
| 0 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 5 | 2 | 43 | 3.0562 | Opt | 0.211 | 3.2885 | 0 | 0.076 |
| 0 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 1 | 0 | 49 | 3.8323 | Opt | 0.05 | 3.848 | 0 | 0.0041 |
| 0 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 0 | 47 | 4.6948 | Opt | 0.24 | 4.9737 | 0 | 0.0594 |
| 0 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 3 | 0 | 47 | 5.7446 | Opt | 0.411 | 6.0441 | 0 | 0.0521 |
| 0 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 6.5701 | Opt | 0.03 | 6.5701 | 0 | 0 |
| 0 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 2.2843 | Opt | 0.03 | 2.7001 | 0 | 0.182 |
| 0 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 2.8016 | Opt | 0.03 | 2.9666 | 0 | 0.0589 |
| 0 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 3.463 | Opt | 0.04 | 4.3481 | 0 | 0.2556 |
| 0 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 3.9851 | Opt | 0.03 | 4.5375 | 0 | 0.1386 |
| 0 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 5.1555 | Opt | 0.03 | 6.004 | 0 | 0.1646 |
| 0 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 5.6932 | Opt | 0.03 | 6.2919 | 0 | 0.1052 |
| 0 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.4439 | Opt | 0.03 | 7.6202 | 0 | 0.1825 |
| 0 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 6.9883 | Opt | 0.03 | 7.8409 | 0 | 0.122 |
| 0 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 2.2843 | Opt | 0.04 | 2.4312 | 0 | 0.0643 |
| 0 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 3.463 | Opt | 0.03 | 3.8312 | 0 | 0.1063 |
| 0 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 3.9851 | Opt | 0.03 | 4.0311 | 0.01 | 0.0115 |
| 0 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 5.1555 | Opt | 0.03 | 5.3862 | 0 | 0.0448 |
| 0 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.4439 | Opt | 0.031 | 6.8193 | 0.01 | 0.0583 |
| 0 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 6.9883 | Opt | 0.03 | 6.9883 | 0 | 0 |
| 0 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 2.3089 | Opt | 0.03 | 2.9993 | 0.01 | 0.299 |
| 0 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 2.8347 | Opt | 0.03 | 3.1146 | 0 | 0.0988 |
| 0 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 3.5405 | Opt | 0.03 | 5.3026 | 0.01 | 0.4977 |
| 0 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 4.0804 | Opt | 0.03 | 5.201 | 0 | 0.2746 |
| 0 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 5.36 | Opt | 0.04 | 6.7941 | 0 | 0.2676 |
| 0 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 5.9295 | Opt | 0.03 | 6.9537 | 0.01 | 0.1727 |
| 0 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.8158 | Opt | 0.03 | 9.0536 | 0 | 0.3283 |
| 0 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 7.4065 | Opt | 0.04 | 9.1924 | 0 | 0.2411 |
| 0 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 2.3089 | Opt | 0.03 | 2.5304 | 0 | 0.0959 |
| 0 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 3.5405 | Opt | 0.04 | 4.2205 | 0 | 0.192 |
| 0 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 4.0804 | Opt | 0.03 | 4.1647 | 0.01 | 0.0207 |
| 0 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 5.36 | Opt | 0.03 | 5.7419 | 0 | 0.0713 |
| 0 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.8158 | Opt | 0.04 | 7.5187 | 0 | 0.1031 |
| 0 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 7.4065 | Opt | 0.03 | 7.4065 | 0.01 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 0 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 11 | 2 | 37 | 2.033 | Opt | 0.211 | 3.1109 | 0 | 0.5302 |
| 0 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 6 | 2 | 42 | 3.2514 | Opt | 0.19 | 3.7044 | 0 | 0.1393 |
| 0 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 11 | 2 | 37 | 2.9203 | Opt | 0.451 | 4.1967 | 0 | 0.4371 |
| 0 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 8 | 1 | 41 | 4.0584 | Opt | 0.15 | 4.8339 | 0.01 | 0.1911 |
| 0 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 8 | 0 | 42 | 4.757 | Opt | 0.29 | 6.6607 | 0 | 0.4002 |
| 0 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 6 | 0 | 44 | 5.9988 | Opt | 0.11 | 7.3136 | 0 | 0.2192 |
| 0 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 8 | 0 | 42 | 5.762 | Opt | 0.241 | 7.7337 | 0 | 0.3422 |
| 0 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 6 | 0 | 44 | 6.9772 | Opt | 1.482 | 8.4109 | 0 | 0.2055 |
| 0 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 2 | 43 | 2.3642 | Opt | 0.16 | 2.7296 | 0.01 | 0.1546 |
| 0 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0.01 | 0 |
| 0 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 5 | 2 | 43 | 3.3676 | Opt | 0.19 | 3.8296 | 0 | 0.1372 |
| 0 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 1 | 0 | 49 | 4.6949 | Opt | 0.05 | 4.7262 | 0.01 | 0.0067 |
| 0 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 0 | 47 | 5.465 | Opt | 0.231 | 6.0174 | 0 | 0.1011 |
| 0 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 3 | 0 | 47 | 6.607 | Opt | 0.611 | 7.1727 | 0 | 0.0856 |
| 0 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 8.0074 | Opt | 0.04 | 8.0074 | 0 | 0 |
| 0 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 2.6243 | Opt | 0.04 | 3.52 | 0 | 0.3413 |
| 0 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 3.6558 | Opt | 0.04 | 4.0041 | 0 | 0.0953 |
| 0 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 3.8336 | Opt | 0.04 | 5.2458 | 0 | 0.3684 |
| 0 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 4.8671 | Opt | 0.04 | 5.7574 | 0 | 0.1829 |
| 0 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 5.9779 | Opt | 0.03 | 7.6596 | 0 | 0.2813 |
| 0 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 7.0392 | Opt | 0.04 | 8.1451 | 0 | 0.1571 |
| 0 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 7.3632 | Opt | 0.04 | 9.4515 | 0 | 0.2836 |
| 0 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 8.4256 | Opt | 0.04 | 9.9052 | 0 | 0.1756 |
| 0 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 2.6243 | Opt | 0.04 | 2.917 | 0 | 0.1116 |
| 0 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 3.8336 | Opt | 0.03 | 4.4259 | 0.01 | 0.1545 |
| 0 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 4.8671 | Opt | 0.04 | 4.9416 | 0 | 0.0153 |
| 0 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 5.9779 | Opt | 0.03 | 6.4219 | 0.01 | 0.0743 |
| 0 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 0 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 7.3632 | Opt | 0.031 | 8.0145 | 0.01 | 0.0884 |
| 0 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 8.4256 | Opt | 0.03 | 8.4256 | 0.01 | 0 |
| 0 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 2.6489 | Opt | 0.03 | 3.8117 | 0.01 | 0.439 |
| 0 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 3.6889 | Opt | 0.03 | 4.1496 | 0 | 0.1249 |
| 0 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 3.9111 | Opt | 0.03 | 6.2739 | 0.01 | 0.6041 |
| 0 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 4.9624 | Opt | 0.03 | 6.4414 | 0 | 0.2981 |
| 0 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 6.1823 | Opt | 0.04 | 8.5203 | 0 | 0.3782 |
| 0 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 7.2756 | Opt | 0.03 | 8.9185 | 0.01 | 0.2258 |
| 0 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 7.7351 | Opt | 0.04 | 10.903 | 0 | 0.4096 |
| 0 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 8.8438 | Opt | 0.03 | 11.181 | 0.01 | 0.2642 |
| 0 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 2.6489 | Opt | 0.03 | 3.0649 | 0 | 0.157 |
| 0 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 0 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 3.9111 | Opt | 0.04 | 4.9117 | 0 | 0.2558 |
| 0 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 4.9624 | Opt | 0.04 | 5.0874 | 0 | 0.0252 |
| 0 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 6.1823 | Opt | 0.04 | 6.8241 | 0 | 0.1038 |
| 0 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 7.7351 | Opt | 0.03 | 8.7523 | 0.01 | 0.1315 |
| 0 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 8.8438 | Opt | 0.03 | 8.8438 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 0 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 11 | 2 | 37 | 3.3797 | Opt | 0.181 | 3.9324 | 0 | 0.1635 |
| 0 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 6 | 2 | 42 | 4.2857 | Opt | 0.17 | 4.5296 | 0 | 0.0569 |
| 0 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 11 | 2 | 37 | 5.0926 | Opt | 0.36 | 5.7528 | 0 | 0.1297 |
| 0 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 8 | 1 | 41 | 5.9574 | Opt | 0.171 | 6.367 | 0 | 0.0688 |
| 0 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 8 | 0 | 42 | 7.571 | Opt | 0.731 | 8.5267 | 0 | 0.1262 |
| 0 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 6 | 0 | 44 | 8.4989 | Opt | 0.19 | 9.1571 | 0 | 0.0774 |
| 0 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 8 | 0 | 42 | 9.3415 | Opt | 0.601 | 10.336 | 0 | 0.1065 |
| 0 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 6 | 0 | 44 | 10.254 | Opt | 1.061 | 10.988 | 0 | 0.0715 |
| 0 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 2 | 43 | 3.8615 | Opt | 0.261 | 4.0616 | 0 | 0.0518 |
| 0 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 5 | 2 | 43 | 5.8009 | Opt | 0.15 | 6.0358 | 0.01 | 0.0405 |
| 0 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 1 | 0 | 49 | 6.802 | Opt | 0.05 | 6.8177 | 0 | 0.0023 |
| 0 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 0 | 47 | 8.6194 | Opt | 0.371 | 8.9038 | 0 | 0.033 |
| 0 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 3 | 0 | 47 | 10.627 | Opt | 0.46 | 10.96 | 0.01 | 0.0313 |
| 0 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 11.703 | Opt | 0.03 | 11.703 | 0 | 0 |
| 0 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 4.2039 | Opt | 0.03 | 4.2915 | 0 | 0.0208 |
| 0 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 4.7158 | Opt | 0.04 | 4.7518 | 0 | 0.0076 |
| 0 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.4781 | Opt | 0.031 | 6.7717 | 0 | 0.0453 |
| 0 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 6.993 | Opt | 0.03 | 7.177 | 0 | 0.0263 |
| 0 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 9.2842 | Opt | 0.04 | 9.486 | 0 | 0.0217 |
| 0 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 9.8039 | Opt | 0.05 | 9.952 | 0 | 0.0151 |
| 0 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 11.597 | Opt | 0.03 | 11.954 | 0 | 0.0308 |
| 0 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 12.121 | Opt | 0.03 | 12.412 | 0 | 0.024 |
| 0 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 4.2039 | Opt | 0.03 | 4.2287 | 0 | 0.0059 |
| 0 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.4781 | Opt | 0.03 | 6.582 | 0 | 0.016 |
| 0 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 6.993 | Opt | 0.03 | 7.0058 | 0.01 | 0.0018 |
| 0 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 9.2842 | Opt | 0.03 | 9.3346 | 0 | 0.0054 |
| 0 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 11.597 | Opt | 0.03 | 11.706 | 0 | 0.0094 |
| 0 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 12.121 | Opt | 0.04 | 12.121 | 0 | 0 |
| 0 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 4.2285 | Opt | 0.04 | 4.5791 | 0 | 0.0829 |
| 0 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 4.7489 | Opt | 0.03 | 4.8929 | 0 | 0.0303 |
| 0 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.5556 | Opt | 0.03 | 7.7301 | 0 | 0.1792 |
| 0 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 7.0883 | Opt | 0.04 | 7.8242 | 0 | 0.1038 |
| 0 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 9.4887 | Opt | 0.04 | 10.296 | 0 | 0.0851 |
| 0 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 10.04 | Opt | 0.041 | 10.633 | 0 | 0.059 |
| 0 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 11.969 | Opt | 0.04 | 13.397 | 0 | 0.1194 |
| 0 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 12.539 | Opt | 0.04 | 13.703 | 0 | 0.0928 |
| 0 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 4.2285 | Opt | 0.03 | 4.3279 | 0.01 | 0.0235 |
| 0 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 0 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.5556 | Opt | 0.03 | 6.9712 | 0.01 | 0.0634 |
| 0 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 7.0883 | Opt | 0.03 | 7.1395 | 0 | 0.0072 |
| 0 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 9.4887 | Opt | 0.04 | 9.6903 | 0 | 0.0212 |
| 0 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 11.969 | Opt | 0.03 | 12.405 | 0.01 | 0.0365 |
| 0 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 12.539 | Opt | 0.03 | 12.539 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 0 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 11 | 2 | 37 | 3.6085 | Opt | 0.16 | 4.6892 | 0 | 0.2995 |
| 0 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 6 | 2 | 42 | 5.0248 | Opt | 0.16 | 5.4893 | 0.01 | 0.0925 |
| 0 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 11 | 2 | 37 | 5.3419 | Opt | 0.231 | 6.633 | 0 | 0.2417 |
| 0 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 8 | 1 | 41 | 6.6775 | Opt | 0.12 | 7.4673 | 0 | 0.1183 |
| 0 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 8 | 0 | 42 | 8.2198 | Opt | 0.35 | 10.125 | 0 | 0.2318 |
| 0 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 6 | 0 | 44 | 9.6652 | Opt | 0.131 | 10.98 | 0 | 0.1361 |
| 0 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 8 | 0 | 42 | 10.07 | Opt | 0.37 | 12.046 | 0 | 0.1963 |
| 0 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 6 | 0 | 44 | 11.488 | Opt | 2.444 | 12.955 | 0 | 0.1277 |
| 0 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 2 | 43 | 4.1504 | Opt | 0.19 | 4.5249 | 0 | 0.0902 |
| 0 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 5 | 2 | 43 | 6.1124 | Opt | 0.19 | 6.5769 | 0 | 0.076 |
| 0 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 1 | 0 | 49 | 7.6646 | Opt | 0.06 | 7.6959 | 0 | 0.0041 |
| 0 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 0 | 47 | 9.3896 | Opt | 0.261 | 9.9475 | 0 | 0.0594 |
| 0 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 3 | 0 | 47 | 11.489 | Opt | 0.41 | 12.088 | 0 | 0.0521 |
| 0 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 13.14 | Opt | 0.04 | 13.14 | 0 | 0 |
| 0 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 4.5439 | Opt | 0.03 | 5.0983 | 0.01 | 0.122 |
| 0 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 5.57 | Opt | 0.031 | 5.7748 | 0 | 0.0368 |
| 0 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.8486 | Opt | 0.03 | 7.6821 | 0 | 0.1217 |
| 0 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 7.875 | Opt | 0.04 | 8.3778 | 0 | 0.0638 |
| 0 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 10.107 | Opt | 0.03 | 11.137 | 0.01 | 0.102 |
| 0 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 11.15 | Opt | 0.03 | 11.786 | 0 | 0.057 |
| 0 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 12.516 | Opt | 0.03 | 13.752 | 0 | 0.0987 |
| 0 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 13.558 | Opt | 0.04 | 14.396 | 0 | 0.0617 |
| 0 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 4.5439 | Opt | 0.04 | 4.729 | 0 | 0.0407 |
| 0 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.8486 | Opt | 0.04 | 7.2016 | 0 | 0.0515 |
| 0 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 7.875 | Opt | 0.03 | 7.9113 | 0.01 | 0.0046 |
| 0 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 10.107 | Opt | 0.03 | 10.427 | 0 | 0.0317 |
| 0 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 0 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 12.516 | Opt | 0.04 | 12.856 | 0 | 0.0272 |
| 0 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 13.558 | Opt | 0.04 | 13.558 | 0 | 0 |
| 0 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 4.5685 | Opt | 0.04 | 5.4002 | 0 | 0.182 |
| 0 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 5.6031 | Opt | 0.03 | 5.9332 | 0.01 | 0.0589 |
| 0 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.9261 | Opt | 0.03 | 8.6962 | 0 | 0.2556 |
| 0 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 7.9703 | Opt | 0.03 | 9.0749 | 0 | 0.1386 |
| 0 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 10.311 | Opt | 0.04 | 12.008 | 0 | 0.1646 |
| 0 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 0 | 50 | 11.386 | Opt | 0.031 | 12.584 | 0.01 | 0.1052 |
| 0 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 12.888 | Opt | 0.03 | 15.241 | 0 | 0.1826 |
| 0 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 13.977 | Opt | 0.03 | 15.682 | 0 | 0.122 |
| 0 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 4.5685 | Opt | 0.04 | 4.8624 | 0 | 0.0643 |
| 0 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0 | 0 | 0 | 0 |
| 0 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 6.9261 | Opt | 0.03 | 7.6625 | 0 | 0.1063 |
| 0 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 7.9703 | Opt | 0.04 | 8.0622 | 0 | 0.0115 |
| 0 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 0 | 50 | 10.311 | Opt | 0.03 | 10.773 | 0.01 | 0.0448 |
| 0 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 0 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 0 | 50 | 12.888 | Opt | 0.04 | 13.639 | 0 | 0.0583 |
| 0 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 13.977 | Opt | 0.03 | 13.977 | 0.01 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 5 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 2 | 38 | 10 | 290 | Opt | 0.04 | 295 | 0.01 | 0.0172 |
| 5 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 375 | Opt | 0.05 | 375 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 265 | Opt | 0.05 | 265 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 315 | Opt | 0.04 | 315 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 2 | 18 | 30 | 390 | Opt | 0.05 | 390 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 2 | 11 | 37 | 425 | Opt | 0.05 | 425 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 380 | Opt | 0.051 | 380 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 410 | Opt | 0.06 | 410 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 375 | Opt | 0.05 | 375 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 350 | Opt | 0.04 | 350 | 0.01 | 0 |
| 5 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 465 | Opt | 0.05 | 465 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 1 | 5 | 44 | 465 | Opt | 0.05 | 465 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 460 | Opt | 0.05 | 460 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 500 | Opt | 0.04 | 500 | 0 | 0 |
| 5 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 290.42 | Opt | 0.06 | 295.37 | 0 | 0.017 |
| 5 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 375.24 | Opt | 0.05 | 375.26 | 0 | 5E-05 |
| 5 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 266.05 | Opt | 0.05 | 266.05 | 0 | 0 |
| 5 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 315.88 | Opt | 0.05 | 315.88 | 0 | 0 |
| 5 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 390.89 | Opt | 0.05 | 390.9 | 0 | 3E-05 |
| 5 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 425.73 | Opt | 0.05 | 425.74 | 0 | 2E-05 |
| 5 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 381.57 | Opt | 0.06 | 381.57 | 0 | 0 |
| 5 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 411.35 | Opt | 0.06 | 411.35 | 0 | 0 |
| 5 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 375.19 | Opt | 0.05 | 375.2 | 0.01 | 3E-05 |
| 5 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 5 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 350.6 | Opt | 0.05 | 350.6 | 0 | 0 |
| 5 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 465.2 | Opt | 0.05 | 465.21 | 0.01 | 3E-05 |
| 5 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 465.39 | Opt | 0.05 | 465.39 | 0 | 0 |
| 5 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 460.71 | Opt | 0.05 | 460.71 | 0 | 0 |
| 5 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 500.42 | Opt | 0.04 | 500.42 | 0 | 0 |
| 5 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 290.84 | Opt | 0.06 | 295.74 | 0 | 0.0168 |
| 5 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 375.48 | Opt | 0.05 | 375.52 | 0 | 9E-05 |
| 5 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 267.07 | Opt | 0.05 | 267.1 | 0 | 0.0001 |
| 5 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 316.76 | Opt | 0.051 | 316.76 | 0.01 | 0 |
| 5 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 391.79 | Opt | 0.05 | 391.81 | 0 | 5E-05 |
| 5 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 426.46 | Opt | 0.06 | 426.48 | 0 | 5E-05 |
| 5 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 383.06 | Opt | 0.07 | 383.14 | 0 | 0.0002 |
| 5 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 412.64 | Opt | 0.06 | 412.7 | 0 | 0.0002 |
| 5 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 375.38 | Opt | 0.05 | 375.4 | 0 | 5E-05 |
| 5 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 351.21 | Opt | 0.05 | 351.21 | 0 | 0 |
| 5 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 465.39 | Opt | 0.05 | 465.42 | 0 | 6E-05 |
| 5 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 465.78 | Opt | 0.04 | 465.78 | 0.01 | 0 |
| 5 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 5 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 461.42 | Opt | 0.05 | 461.42 | 0 | 0 |
| 5 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 500.84 | Opt | 0.03 | 500.84 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 5 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 32 | 13 | 290.62 | Opt | 0.06 | 295.77 | 0 | 0.0177 |
| 5 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 375.95 | Opt | 0.061 | 375.98 | 0 | 9E-05 |
| 5 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 1 | 45 | 4 | 265.85 | Opt | 0.05 | 265.9 | 0 | 0.0002 |
| 5 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 316.15 | Opt | 0.05 | 316.15 | 0.01 | 0 |
| 5 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 391.21 | Opt | 0.05 | 391.68 | 0 | 0.0012 |
| 5 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 426.48 | Opt | 0.06 | 426.88 | 0 | 0.0009 |
| 5 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 381.66 | Opt | 0.16 | 381.77 | 0 | 0.0003 |
| 5 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 411.91 | Opt | 0.18 | 412.02 | 0 | 0.0003 |
| 5 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 375.48 | Opt | 0.06 | 375.48 | 0 | 0 |
| 5 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 350.56 | Opt | 0.051 | 350.56 | 0.01 | 0 |
| 5 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 465.88 | Opt | 0.05 | 465.88 | 0 | 0 |
| 5 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 465.83 | Opt | 0.05 | 466.08 | 0 | 0.0006 |
| 5 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 461.11 | Opt | 0.05 | 461.19 | 0 | 0.0002 |
| 5 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 501.44 | Opt | 0.06 | 501.44 | 0 | 0 |
| 5 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 291.19 | Opt | 0.04 | 296.14 | 0 | 0.017 |
| 5 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 376.24 | Opt | 0.05 | 376.24 | 0 | 0 |
| 5 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 266.94 | Opt | 0.05 | 266.94 | 0 | 0 |
| 5 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 317.03 | Opt | 0.04 | 317.03 | 0.01 | 0 |
| 5 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 392.58 | Opt | 0.05 | 392.58 | 0 | 0 |
| 5 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 427.62 | Opt | 0.05 | 427.62 | 0 | 2E-06 |
| 5 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 383.34 | Opt | 0.05 | 383.34 | 0.01 | 0 |
| 5 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 413.37 | Opt | 0.051 | 413.37 | 0 | 0 |
| 5 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 375.69 | Opt | 0.04 | 375.69 | 0.01 | 0 |
| 5 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 5 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 351.16 | Opt | 0.05 | 351.16 | 0 | 0 |
| 5 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 466.09 | Opt | 0.04 | 466.09 | 0.01 | 4E-06 |
| 5 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 466.47 | Opt | 0.05 | 466.48 | 0.01 | 1E-05 |
| 5 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 5 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 461.9 | Opt | 0.05 | 461.9 | 0 | 0 |
| 5 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 501.86 | Opt | 0.03 | 501.86 | 0 | 0 |
| 5 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 291.61 | Opt | 0.05 | 296.51 | 0 | 0.0168 |
| 5 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 376.49 | Opt | 0.06 | 376.49 | 0 | 0 |
| 5 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 267.99 | Opt | 0.05 | 267.99 | 0 | 0 |
| 5 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 317.9 | Opt | 0.06 | 317.9 | 0 | 0 |
| 5 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 393.48 | Opt | 0.06 | 393.48 | 0 | 1E-05 |
| 5 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 428.35 | Opt | 0.061 | 428.36 | 0 | 3E-05 |
| 5 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 384.91 | Opt | 0.06 | 384.91 | 0 | 0 |
| 5 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 414.73 | Opt | 0.06 | 414.73 | 0 | 0 |
| 5 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 375.88 | Opt | 0.05 | 375.89 | 0 | 3E-05 |
| 5 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 351.77 | Opt | 0.05 | 351.77 | 0 | 0 |
| 5 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 466.29 | Opt | 0.05 | 466.3 | 0 | 3E-05 |
| 5 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 466.86 | Opt | 0.05 | 466.86 | 0 | 0 |
| 5 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 462.61 | Opt | 0.06 | 462.61 | 0 | 0 |
| 5 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 502.27 | Opt | 0.04 | 502.27 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 5 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 32 | 13 | 291.24 | Opt | 0.05 | 296.54 | 0 | 0.0182 |
| 5 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 376.89 | Opt | 0.05 | 376.96 | 0 | 0.0002 |
| 5 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 1 | 45 | 4 | 266.7 | Opt | 0.05 | 266.79 | 0 | 0.0003 |
| 5 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 317.3 | Opt | 0.051 | 317.3 | 0.01 | 0 |
| 5 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 392.41 | Opt | 0.06 | 393.35 | 0 | 0.0024 |
| 5 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 427.97 | Opt | 0.06 | 428.76 | 0.01 | 0.0018 |
| 5 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 383.32 | Opt | 0.17 | 383.54 | 0 | 0.0006 |
| 5 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 413.81 | Opt | 0.2 | 414.02 | 0 | 0.0005 |
| 5 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 375.97 | Opt | 0.06 | 375.97 | 0 | 0 |
| 5 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 351.12 | Opt | 0.05 | 351.12 | 0.01 | 0 |
| 5 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 466.77 | Opt | 0.051 | 466.77 | 0 | 0 |
| 5 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 466.65 | Opt | 0.05 | 467.17 | 0.01 | 0.0011 |
| 5 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 5 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 462.2 | Opt | 0.07 | 462.38 | 0 | 0.0004 |
| 5 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 502.88 | Opt | 0.04 | 502.88 | 0 | 0 |
| 5 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 4 | 34 | 12 | 291.9 | Opt | 0.05 | 296.91 | 0 | 0.0172 |
| 5 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 377.21 | Opt | 0.06 | 377.21 | 0 | 0 |
| 5 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 267.84 | Opt | 0.05 | 267.84 | 0 | 0 |
| 5 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 318.18 | Opt | 0.05 | 318.18 | 0 | 0 |
| 5 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 394.04 | Opt | 0.05 | 394.26 | 0.01 | 0.0005 |
| 5 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 429.32 | Opt | 0.06 | 429.5 | 0 | 0.0004 |
| 5 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 385.11 | Opt | 0.06 | 385.11 | 0 | 0 |
| 5 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 415.4 | Opt | 0.06 | 415.4 | 0 | 0 |
| 5 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 376.17 | Opt | 0.051 | 376.17 | 0.01 | 0 |
| 5 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 5 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 351.72 | Opt | 0.05 | 351.72 | 0.01 | 0 |
| 5 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 466.98 | Opt | 0.05 | 466.98 | 0 | 0 |
| 5 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 467.46 | Opt | 0.06 | 467.56 | 0 | 0.0002 |
| 5 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 463.09 | Opt | 0.05 | 463.09 | 0.01 | 0 |
| 5 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 503.29 | Opt | 0.03 | 503.29 | 0.01 | 0 |
| 5 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 292.37 | Opt | 0.05 | 297.28 | 0 | 0.0168 |
| 5 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 377.47 | Opt | 0.06 | 377.47 | 0 | 0 |
| 5 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 268.89 | Opt | 0.06 | 268.89 | 0 | 0 |
| 5 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 319.05 | Opt | 0.05 | 319.05 | 0 | 0 |
| 5 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 395.16 | Opt | 0.06 | 395.16 | 0 | 0 |
| 5 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 430.24 | Opt | 0.06 | 430.24 | 0 | 7E-06 |
| 5 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 386.68 | Opt | 0.061 | 386.68 | 0 | 0 |
| 5 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 416.75 | Opt | 0.06 | 416.75 | 0 | 0 |
| 5 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 376.37 | Opt | 0.05 | 376.37 | 0 | 0 |
| 5 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 5 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 352.33 | Opt | 0.05 | 352.33 | 0 | 0 |
| 5 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 467.18 | Opt | 0.06 | 467.19 | 0 | 1E-05 |
| 5 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 467.95 | Opt | 0.06 | 467.95 | 0 | 1E-05 |
| 5 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 463.8 | Opt | 0.05 | 463.8 | 0 | 0 |
| 5 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 503.71 | Opt | 0.04 | 503.71 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 5 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 32 | 13 | 292.2 | Opt | 0.05 | 297.36 | 0.01 | 0.0177 |
| 5 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 377.72 | Opt | 0.05 | 377.76 | 0.01 | 9E-05 |
| 5 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 1 | 45 | 4 | 268.27 | Opt | 0.05 | 268.32 | 0 | 0.0002 |
| 5 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 318.76 | Opt | 0.05 | 318.76 | 0.01 | 0 |
| 5 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 394.68 | Opt | 0.061 | 395.15 | 0 | 0.0012 |
| 5 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 430.15 | Opt | 0.06 | 430.55 | 0 | 0.0009 |
| 5 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 385.97 | Opt | 0.16 | 386.1 | 0 | 0.0003 |
| 5 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 416.41 | Opt | 0.17 | 416.55 | 0 | 0.0003 |
| 5 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 377.27 | Opt | 0.06 | 377.27 | 0 | 0 |
| 5 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 353.31 | Opt | 0.05 | 353.31 | 0 | 0 |
| 5 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 468.85 | Opt | 0.05 | 468.85 | 0 | 9E-06 |
| 5 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 469.75 | Opt | 0.05 | 470.02 | 0 | 0.0006 |
| 5 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.021 | 0 | 0 | 0 |
| 5 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 466 | Opt | 0.06 | 466.1 | 0 | 0.0002 |
| 5 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 506.57 | Opt | 0.04 | 506.57 | 0 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 292.76 | Opt | 0.05 | 297.73 | 0.01 | 0.017 |
| 5 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 378.01 | Opt | 0.05 | 378.01 | 0 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 269.37 | Opt | 0.05 | 269.37 | 0 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 319.64 | Opt | 0.05 | 319.64 | 0 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 396.05 | Opt | 0.06 | 396.05 | 0 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 431.29 | Opt | 0.06 | 431.3 | 0 | 5E-06 |
| 5 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 387.67 | Opt | 0.06 | 387.67 | 0 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 417.9 | Opt | 0.06 | 417.9 | 0 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 377.48 | Opt | 0.06 | 377.48 | 0 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 353.91 | Opt | 0.061 | 353.91 | 0 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 469.06 | Opt | 0.05 | 469.06 | 0.01 | 9E-06 |
| 5 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 470.41 | Opt | 0.05 | 470.41 | 0.01 | 1E-05 |
| 5 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 466.8 | Opt | 0.06 | 466.8 | 0 | 0 |
| 5 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 506.99 | Opt | 0.04 | 506.99 | 0 | 0 |
| 5 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 293.18 | Opt | 0.06 | 298.1 | 0 | 0.0168 |
| 5 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 378.25 | Opt | 0.06 | 378.27 | 0 | 4E-05 |
| 5 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 270.42 | Opt | 0.06 | 270.42 | 0 | 0 |
| 5 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 320.52 | Opt | 0.05 | 320.52 | 0 | 0 |
| 5 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 396.94 | Opt | 0.06 | 396.95 | 0 | 2E-05 |
| 5 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 432.02 | Opt | 0.06 | 432.04 | 0.01 | 4E-05 |
| 5 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 389.24 | Opt | 0.06 | 389.24 | 0 | 0 |
| 5 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 419.26 | Opt | 0.051 | 419.26 | 0.01 | 0 |
| 5 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 377.66 | Opt | 0.05 | 377.68 | 0 | 4E-05 |
| 5 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 354.51 | Opt | 0.05 | 354.51 | 0 | 0 |
| 5 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 469.25 | Opt | 0.06 | 469.27 | 0 | 4E-05 |
| 5 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 470.8 | Opt | 0.05 | 470.8 | 0 | 0 |
| 5 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 467.51 | Opt | 0.06 | 467.51 | 0 | 0 |
| 5 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 507.41 | Opt | 0.04 | 507.41 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 5 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 32 | 13 | 292.82 | Opt | 0.06 | 298.13 | 0 | 0.0181 |
| 5 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 378.67 | Opt | 0.06 | 378.73 | 0.01 | 0.0002 |
| 5 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 1 | 45 | 4 | 269.12 | Opt | 0.05 | 269.22 | 0.01 | 0.0004 |
| 5 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 319.91 | Opt | 0.05 | 319.91 | 0 | 0 |
| 5 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 395.88 | Opt | 0.06 | 396.82 | 0.01 | 0.0024 |
| 5 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 431.63 | Opt | 0.071 | 432.43 | 0 | 0.0019 |
| 5 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 387.63 | Opt | 0.2 | 387.87 | 0 | 0.0006 |
| 5 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 418.32 | Opt | 0.24 | 418.55 | 0 | 0.0006 |
| 5 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 377.76 | Opt | 0.06 | 377.76 | 0 | 0 |
| 5 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 353.87 | Opt | 0.05 | 353.87 | 0 | 0 |
| 5 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 469.73 | Opt | 0.061 | 469.74 | 0 | 1E-05 |
| 5 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 470.58 | Opt | 0.06 | 471.1 | 0 | 0.0011 |
| 5 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 467.09 | Opt | 0.08 | 467.29 | 0 | 0.0004 |
| 5 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 508.01 | Opt | 0.04 | 508.01 | 0 | 0 |
| 5 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 4 | 34 | 12 | 293.47 | Opt | 0.06 | 298.5 | 0 | 0.0171 |
| 5 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 378.98 | Opt | 0.06 | 378.99 | 0 | 2E-05 |
| 5 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 270.27 | Opt | 0.05 | 270.27 | 0 | 0 |
| 5 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 320.79 | Opt | 0.05 | 320.79 | 0 | 0 |
| 5 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 397.5 | Opt | 0.05 | 397.72 | 0.01 | 0.0006 |
| 5 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 432.99 | Opt | 0.06 | 433.17 | 0 | 0.0004 |
| 5 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 389.41 | Opt | 0.06 | 389.44 | 0 | 6E-05 |
| 5 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 419.9 | Opt | 0.06 | 419.93 | 0 | 6E-05 |
| 5 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 377.96 | Opt | 0.051 | 377.96 | 0 | 0 |
| 5 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 5 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 354.47 | Opt | 0.05 | 354.47 | 0 | 0 |
| 5 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 469.94 | Opt | 0.05 | 469.94 | 0.01 | 0 |
| 5 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 471.39 | Opt | 0.06 | 471.5 | 0 | 0.0002 |
| 5 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 467.99 | Opt | 0.06 | 467.99 | 0 | 0 |
| 5 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 508.43 | Opt | 0.04 | 508.43 | 0.01 | 0 |
| 5 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 293.95 | Opt | 0.05 | 298.87 | 0 | 0.0167 |
| 5 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 379.25 | Opt | 0.06 | 379.25 | 0 | 0 |
| 5 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 271.32 | Opt | 0.05 | 271.32 | 0 | 0 |
| 5 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 321.67 | Opt | 0.05 | 321.67 | 0.01 | 0 |
| 5 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 398.63 | Opt | 0.06 | 398.63 | 0 | 0 |
| 5 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 433.91 | Opt | 0.061 | 433.92 | 0 | 9E-06 |
| 5 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 391.01 | Opt | 0.06 | 391.01 | 0 | 0 |
| 5 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 421.28 | Opt | 0.06 | 421.28 | 0 | 0 |
| 5 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 378.16 | Opt | 0.06 | 378.16 | 0 | 0 |
| 5 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 5 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 355.07 | Opt | 0.05 | 355.07 | 0 | 0 |
| 5 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 470.15 | Opt | 0.06 | 470.15 | 0 | 1E-05 |
| 5 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 471.88 | Opt | 0.06 | 471.89 | 0 | 2E-05 |
| 5 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 468.7 | Opt | 0.06 | 468.7 | 0 | 0 |
| 5 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 508.84 | Opt | 0.04 | 508.84 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 5 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 32 | 13 | 293.77 | Opt | 0.06 | 298.95 | 0 | 0.0176 |
| 5 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 379.49 | Opt | 0.06 | 379.53 | 0 | 0.0001 |
| 5 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 1 | 45 | 4 | 270.69 | Opt | 0.05 | 270.75 | 0 | 0.0002 |
| 5 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 321.38 | Opt | 0.061 | 321.38 | 0 | 0 |
| 5 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 398.14 | Opt | 0.06 | 398.61 | 0 | 0.0012 |
| 5 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 433.82 | Opt | 0.07 | 434.23 | 0 | 0.001 |
| 5 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 390.28 | Opt | 0.18 | 390.43 | 0 | 0.0004 |
| 5 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 420.92 | Opt | 0.24 | 421.08 | 0 | 0.0004 |
| 5 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 379.06 | Opt | 0.06 | 379.06 | 0 | 5E-06 |
| 5 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 5 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 356.05 | Opt | 0.051 | 356.05 | 0 | 0 |
| 5 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 471.82 | Opt | 0.06 | 471.82 | 0 | 1E-05 |
| 5 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 473.68 | Opt | 0.06 | 473.95 | 0 | 0.0006 |
| 5 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 5 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 470.87 | Opt | 0.06 | 471 | 0 | 0.0003 |
| 5 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 511.7 | Opt | 0.04 | 511.7 | 0.01 | 0 |
| 5 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 294.34 | Opt | 0.05 | 299.32 | 0 | 0.0169 |
| 5 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 379.79 | Opt | 0.06 | 379.79 | 0.01 | 2E-05 |
| 5 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 271.8 | Opt | 0.05 | 271.8 | 0 | 0 |
| 5 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 322.25 | Opt | 0.06 | 322.25 | 0 | 0 |
| 5 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 399.51 | Opt | 0.06 | 399.52 | 0 | 1E-05 |
| 5 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 434.97 | Opt | 0.06 | 434.97 | 0 | 7E-06 |
| 5 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 392 | Opt | 0.06 | 392 | 0 | 0 |
| 5 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 422.43 | Opt | 0.061 | 422.43 | 0.01 | 0 |
| 5 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 379.26 | Opt | 0.05 | 379.26 | 0 | 1E-05 |
| 5 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 5 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 356.65 | Opt | 0.05 | 356.65 | 0 | 0 |
| 5 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 472.03 | Opt | 0.05 | 472.03 | 0 | 8E-06 |
| 5 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 474.34 | Opt | 0.06 | 474.35 | 0 | 2E-05 |
| 5 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 5 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 471.71 | Opt | 0.06 | 471.71 | 0 | 0 |
| 5 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 512.12 | Opt | 0.04 | 512.12 | 0 | 0 |
| 5 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 294.76 | Opt | 0.06 | 299.69 | 0 | 0.0167 |
| 5 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 380.03 | Opt | 0.06 | 380.05 | 0.01 | 6E-05 |
| 5 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 272.85 | Opt | 0.05 | 272.85 | 0 | 0 |
| 5 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 323.13 | Opt | 0.06 | 323.13 | 0 | 0 |
| 5 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 400.41 | Opt | 0.061 | 400.42 | 0.01 | 3E-05 |
| 5 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 435.7 | Opt | 0.06 | 435.71 | 0 | 3E-05 |
| 5 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 393.51 | Opt | 0.06 | 393.57 | 0.01 | 0.0001 |
| 5 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 423.78 | Opt | 0.06 | 423.78 | 0 | 0 |
| 5 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 379.45 | Opt | 0.05 | 379.47 | 0 | 4E-05 |
| 5 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 357.26 | Opt | 0.06 | 357.26 | 0 | 0 |
| 5 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 472.22 | Opt | 0.05 | 472.24 | 0 | 4E-05 |
| 5 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 474.73 | Opt | 0.05 | 474.73 | 0 | 0 |
| 5 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 5 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 472.42 | Opt | 0.06 | 472.42 | 0 | 0 |
| 5 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 512.54 | Opt | 0.04 | 512.54 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 5 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 32 | 13 | 294.39 | Opt | 0.06 | 299.72 | 0 | 0.0181 |
| 5 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 380.41 | Opt | 0.061 | 380.51 | 0.01 | 0.0003 |
| 5 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 1 | 45 | 4 | 271.54 | Opt | 0.05 | 271.65 | 0 | 0.0004 |
| 5 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 322.53 | Opt | 0.05 | 322.53 | 0 | 0 |
| 5 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 399.34 | Opt | 0.07 | 400.29 | 0 | 0.0024 |
| 5 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 435.29 | Opt | 0.15 | 436.11 | 0 | 0.0019 |
| 5 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 391.94 | Opt | 0.21 | 392.2 | 0.01 | 0.0007 |
| 5 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 422.82 | Opt | 0.241 | 423.08 | 0 | 0.0006 |
| 5 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 379.55 | Opt | 0.06 | 379.55 | 0 | 0 |
| 5 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 356.61 | Opt | 0.06 | 356.61 | 0 | 0 |
| 5 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 472.7 | Opt | 0.06 | 472.7 | 0 | 1E-05 |
| 5 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 474.5 | Opt | 0.06 | 475.04 | 0 | 0.0011 |
| 5 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 471.97 | Opt | 0.08 | 472.19 | 0 | 0.0005 |
| 5 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 513.14 | Opt | 0.04 | 513.14 | 0 | 0 |
| 5 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 4 | 34 | 12 | 295.05 | Opt | 0.06 | 300.09 | 0 | 0.0171 |
| 5 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 380.76 | Opt | 0.06 | 380.77 | 0 | 3E-05 |
| 5 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 272.7 | Opt | 0.05 | 272.7 | 0 | 0 |
| 5 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 323.4 | Opt | 0.051 | 323.4 | 0 | 0 |
| 5 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 400.97 | Opt | 0.05 | 401.19 | 0.01 | 0.0006 |
| 5 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 436.66 | Opt | 0.06 | 436.85 | 0 | 0.0004 |
| 5 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 393.73 | Opt | 0.06 | 393.77 | 0 | 9E-05 |
| 5 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 424.42 | Opt | 0.06 | 424.46 | 0.01 | 9E-05 |
| 5 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 379.75 | Opt | 0.05 | 379.75 | 0 | 0 |
| 5 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 357.21 | Opt | 0.06 | 357.21 | 0 | 0 |
| 5 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 472.91 | Opt | 0.05 | 472.91 | 0.01 | 0 |
| 5 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 475.31 | Opt | 0.05 | 475.43 | 0 | 0.0003 |
| 5 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 472.87 | Opt | 0.06 | 472.9 | 0 | 6E-05 |
| 5 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 513.56 | Opt | 0.05 | 513.56 | 0 | 0 |
| 5 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 295.52 | Opt | 0.061 | 300.46 | 0 | 0.0167 |
| 5 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 381.03 | Opt | 0.06 | 381.03 | 0 | 0 |
| 5 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 273.75 | Opt | 0.05 | 273.75 | 0.01 | 0 |
| 5 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 324.28 | Opt | 0.05 | 324.28 | 0.01 | 0 |
| 5 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 402.1 | Opt | 0.06 | 402.1 | 0 | 0 |
| 5 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 437.59 | Opt | 0.06 | 437.59 | 0 | 1E-05 |
| 5 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 395.34 | Opt | 0.06 | 395.34 | 0 | 0 |
| 5 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 425.81 | Opt | 0.06 | 425.81 | 0 | 0 |
| 5 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 379.95 | Opt | 0.06 | 379.95 | 0 | 0 |
| 5 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 357.82 | Opt | 0.05 | 357.82 | 0 | 0 |
| 5 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 473.12 | Opt | 0.05 | 473.12 | 0 | 1E-05 |
| 5 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 475.81 | Opt | 0.061 | 475.82 | 0 | 2E-05 |
| 5 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 5 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 473.61 | Opt | 0.06 | 473.61 | 0 | 0 |
| 5 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 513.98 | Opt | 0.04 | 513.98 | 0.01 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 10 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 2 | 38 | 10 | 580 | Opt | 0.05 | 590 | 0 | 0.0172 |
| 10 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 750 | Opt | 0.06 | 750 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 530 | Opt | 0.06 | 530 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 630 | Opt | 0.06 | 630 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 2 | 18 | 30 | 780 | Opt | 0.05 | 780 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 2 | 11 | 37 | 850 | Opt | 0.05 | 850 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 760 | Opt | 0.05 | 760 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 820 | Opt | 0.06 | 820 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 750 | Opt | 0.06 | 750 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 700 | Opt | 0.061 | 700 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 930 | Opt | 0.05 | 930 | 0.01 | 0 |
| 10 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 1 | 5 | 44 | 930 | Opt | 0.05 | 930 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 920 | Opt | 0.06 | 920 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1000 | Opt | 0.04 | 1000 | 0 | 0 |
| 10 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 580.42 | Opt | 0.06 | 590.37 | 0 | 0.0171 |
| 10 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 750.24 | Opt | 0.06 | 750.26 | 0.01 | 2E-05 |
| 10 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 531.05 | Opt | 0.05 | 531.05 | 0.01 | 0 |
| 10 | 0 | 0 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 630.88 | Opt | 0.05 | 630.88 | 0 | 0 |
| 10 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 780.89 | Opt | 0.06 | 780.9 | 0.01 | 1E-05 |
| 10 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 850.73 | Opt | 0.06 | 850.74 | 0 | 1E-05 |
| 10 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 761.57 | Opt | 0.061 | 761.57 | 0 | 0 |
| 10 | 0 | 0 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 821.35 | Opt | 0.06 | 821.35 | 0 | 0 |
| 10 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 750.19 | Opt | 0.06 | 750.2 | 0 | 2E-05 |
| 10 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 700.6 | Opt | 0.05 | 700.6 | 0 | 0 |
| 10 | 0 | 0 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 930.2 | Opt | 0.05 | 930.21 | 0.01 | 2E-05 |
| 10 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 930.37 | Opt | 0.06 | 930.39 | 0 | 2E-05 |
| 10 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 10 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 920.71 | Opt | 0.05 | 920.71 | 0 | 0 |
| 10 | 0 | 0 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1000.4 | Opt | 0.05 | 1000.4 | 0 | 0 |
| 10 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 580.84 | Opt | 0.06 | 590.74 | 0 | 0.017 |
| 10 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 750.48 | Opt | 0.06 | 750.52 | 0 | 5E-05 |
| 10 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 532.1 | Opt | 0.05 | 532.1 | 0 | 0 |
| 10 | 0 | 0 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 631.76 | Opt | 0.061 | 631.76 | 0 | 0 |
| 10 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 781.79 | Opt | 0.06 | 781.81 | 0 | 3E-05 |
| 10 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 851.46 | Opt | 0.06 | 851.48 | 0 | 2E-05 |
| 10 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 763.14 | Opt | 0.06 | 763.14 | 0 | 0 |
| 10 | 0 | 0 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 822.7 | Opt | 0.06 | 822.7 | 0 | 0 |
| 10 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 750.38 | Opt | 0.06 | 750.41 | 0 | 3E-05 |
| 10 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 701.21 | Opt | 0.06 | 701.21 | 0 | 0 |
| 10 | 0 | 0 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 930.39 | Opt | 0.06 | 930.42 | 0 | 3E-05 |
| 10 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 930.78 | Opt | 0.06 | 930.78 | 0 | 0 |
| 10 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 921.42 | Opt | 0.06 | 921.42 | 0 | 0 |
| 10 | 0 | 0 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1000.8 | Opt | 0.04 | 1000.8 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 10 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 4 | 34 | 12 | 580.66 | Opt | 0.051 | 590.77 | 0 | 0.0174 |
| 10 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 750.95 | Opt | 0.06 | 750.98 | 0.01 | 4E-05 |
| 10 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 530.9 | Opt | 0.05 | 530.9 | 0.01 | 0 |
| 10 | 0 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 631.15 | Opt | 0.05 | 631.15 | 0 | 0 |
| 10 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 781.21 | Opt | 0.06 | 781.68 | 0 | 0.0006 |
| 10 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 851.48 | Opt | 0.06 | 851.88 | 0 | 0.0005 |
| 10 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 761.68 | Opt | 0.06 | 761.77 | 0 | 0.0001 |
| 10 | 0 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 821.92 | Opt | 0.07 | 822.02 | 0 | 0.0001 |
| 10 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 750.48 | Opt | 0.06 | 750.48 | 0 | 0 |
| 10 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 700.56 | Opt | 0.05 | 700.56 | 0 | 0 |
| 10 | 0 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 930.88 | Opt | 0.05 | 930.88 | 0 | 0 |
| 10 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 930.83 | Opt | 0.061 | 931.08 | 0 | 0.0003 |
| 10 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 10 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 921.11 | Opt | 0.06 | 921.19 | 0 | 9E-05 |
| 10 | 0 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1001.4 | Opt | 0.04 | 1001.4 | 0 | 0 |
| 10 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 581.19 | Opt | 0.05 | 591.14 | 0.01 | 0.0171 |
| 10 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 751.24 | Opt | 0.06 | 751.24 | 0 | 0 |
| 10 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 531.94 | Opt | 0.06 | 531.94 | 0 | 0 |
| 10 | 0 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 632.03 | Opt | 0.06 | 632.03 | 0 | 0 |
| 10 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 2 | 18 | 30 | 782.65 | Opt | 0.06 | 782.58 | 0 | -9E-05 |
| 10 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 852.62 | Opt | 0.06 | 852.62 | 0.01 | 1E-06 |
| 10 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 763.34 | Opt | 0.06 | 763.34 | 0 | 0 |
| 10 | 0 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 823.37 | Opt | 0.06 | 823.37 | 0 | 0 |
| 10 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 750.69 | Opt | 0.05 | 750.69 | 0 | 0 |
| 10 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 10 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 701.16 | Opt | 0.06 | 701.16 | 0 | 0 |
| 10 | 0 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 931.09 | Opt | 0.06 | 931.09 | 0 | 2E-06 |
| 10 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 1 | 5 | 44 | 931.52 | Opt | 0.06 | 931.48 | 0 | -5E-05 |
| 10 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 921.9 | Opt | 0.06 | 921.9 | 0 | 0 |
| 10 | 0 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1001.9 | Opt | 0.05 | 1001.9 | 0 | 0 |
| 10 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 581.61 | Opt | 0.06 | 591.51 | 0 | 0.017 |
| 10 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 751.49 | Opt | 0.06 | 751.49 | 0 | 0 |
| 10 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 532.99 | Opt | 0.06 | 532.99 | 0 | 0 |
| 10 | 0 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 632.9 | Opt | 0.06 | 632.9 | 0 | 0 |
| 10 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 783.48 | Opt | 0.06 | 783.48 | 0 | 5E-06 |
| 10 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 853.35 | Opt | 0.06 | 853.36 | 0.01 | 2E-05 |
| 10 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 764.91 | Opt | 0.061 | 764.91 | 0 | 0 |
| 10 | 0 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 824.73 | Opt | 0.06 | 824.73 | 0 | 0 |
| 10 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 750.88 | Opt | 0.05 | 750.89 | 0 | 1E-05 |
| 10 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 10 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 701.77 | Opt | 0.06 | 701.77 | 0 | 0 |
| 10 | 0 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 931.29 | Opt | 0.06 | 931.3 | 0 | 2E-05 |
| 10 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 931.85 | Opt | 0.06 | 931.86 | 0.01 | 2E-05 |
| 10 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 10 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 922.61 | Opt | 0.05 | 922.61 | 0.01 | 0 |
| 10 | 0 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1002.3 | Opt | 0.04 | 1002.3 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 10 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 32 | 13 | 581.24 | Opt | 0.05 | 591.54 | 0.01 | 0.0177 |
| 10 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 751.89 | Opt | 0.06 | 751.96 | 0 | 8E-05 |
| 10 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 1 | 45 | 4 | 531.7 | Opt | 0.061 | 531.79 | 0 | 0.0002 |
| 10 | 0 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 632.3 | Opt | 0.05 | 632.3 | 0 | 0 |
| 10 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 782.43 | Opt | 0.05 | 783.35 | 0.01 | 0.0012 |
| 10 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 852.97 | Opt | 0.06 | 853.76 | 0 | 0.0009 |
| 10 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 763.32 | Opt | 0.16 | 763.54 | 0 | 0.0003 |
| 10 | 0 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 823.81 | Opt | 0.18 | 824.05 | 0.01 | 0.0003 |
| 10 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 750.97 | Opt | 0.06 | 750.97 | 0 | 0 |
| 10 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 701.12 | Opt | 0.05 | 701.12 | 0 | 0 |
| 10 | 0 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 931.77 | Opt | 0.051 | 931.77 | 0 | 0 |
| 10 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 931.65 | Opt | 0.05 | 932.17 | 0.01 | 0.0006 |
| 10 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0.01 | 0 |
| 10 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 922.21 | Opt | 0.06 | 922.38 | 0 | 0.0002 |
| 10 | 0 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1002.9 | Opt | 0.04 | 1002.9 | 0.01 | 0 |
| 10 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 4 | 34 | 12 | 581.9 | Opt | 0.05 | 591.91 | 0 | 0.0172 |
| 10 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 752.21 | Opt | 0.06 | 752.21 | 0 | 3E-06 |
| 10 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 532.84 | Opt | 0.06 | 532.84 | 0 | 0 |
| 10 | 0 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 633.18 | Opt | 0.06 | 633.18 | 0 | 0 |
| 10 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 784.04 | Opt | 0.06 | 784.26 | 0 | 0.0003 |
| 10 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 854.32 | Opt | 0.05 | 854.5 | 0.01 | 0.0002 |
| 10 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 765.11 | Opt | 0.06 | 765.11 | 0 | 0 |
| 10 | 0 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 825.4 | Opt | 0.061 | 825.4 | 0.01 | 0 |
| 10 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 751.17 | Opt | 0.05 | 751.17 | 0.01 | 0 |
| 10 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 10 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 701.72 | Opt | 0.05 | 701.72 | 0 | 0 |
| 10 | 0 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 931.98 | Opt | 0.05 | 931.98 | 0 | 0 |
| 10 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 932.46 | Opt | 0.05 | 932.56 | 0 | 0.0001 |
| 10 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 923.09 | Opt | 0.06 | 923.09 | 0 | 0 |
| 10 | 0 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1003.3 | Opt | 0.05 | 1003.3 | 0 | 0 |
| 10 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 582.37 | Opt | 0.06 | 592.28 | 0 | 0.017 |
| 10 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 752.47 | Opt | 0.07 | 752.47 | 0 | 0 |
| 10 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 533.89 | Opt | 0.05 | 533.89 | 0.01 | 0 |
| 10 | 0 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 634.05 | Opt | 0.06 | 634.05 | 0 | 0 |
| 10 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 785.16 | Opt | 0.071 | 785.16 | 0 | 0 |
| 10 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 855.24 | Opt | 0.07 | 855.24 | 0 | 4E-06 |
| 10 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 766.68 | Opt | 0.06 | 766.68 | 0 | 0 |
| 10 | 0 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 826.75 | Opt | 0.07 | 826.75 | 0 | 0 |
| 10 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 751.37 | Opt | 0.06 | 751.37 | 0.01 | 0 |
| 10 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0.01 | 0 |
| 10 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 702.33 | Opt | 0.06 | 702.33 | 0.01 | 0 |
| 10 | 0 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 932.18 | Opt | 0.07 | 932.19 | 0 | 5E-06 |
| 10 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 932.95 | Opt | 0.07 | 932.96 | 0 | 1E-05 |
| 10 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 923.8 | Opt | 0.06 | 923.8 | 0 | 0 |
| 10 | 0 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1003.7 | Opt | 0.051 | 1003.7 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 10 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 4 | 34 | 12 | 582.23 | Opt | 0.07 | 592.36 | 0 | 0.0174 |
| 10 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 752.72 | Opt | 0.07 | 752.76 | 0.01 | 5E-05 |
| 10 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 1 | 45 | 4 | 533.27 | Opt | 0.07 | 533.32 | 0 | 1E-04 |
| 10 | 0.5 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 633.76 | Opt | 0.07 | 633.76 | 0 | 0 |
| 10 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 784.68 | Opt | 0.06 | 785.15 | 0.01 | 0.0006 |
| 10 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 855.15 | Opt | 0.07 | 855.55 | 0 | 0.0005 |
| 10 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 765.99 | Opt | 0.07 | 766.1 | 0 | 0.0001 |
| 10 | 0.5 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 826.43 | Opt | 0.07 | 826.55 | 0 | 0.0001 |
| 10 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 752.27 | Opt | 0.06 | 752.27 | 0 | 0 |
| 10 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 703.31 | Opt | 0.061 | 703.31 | 0 | 0 |
| 10 | 0.5 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 933.85 | Opt | 0.06 | 933.85 | 0 | 4E-06 |
| 10 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 934.75 | Opt | 0.06 | 935.02 | 0.01 | 0.0003 |
| 10 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0.01 | 0 |
| 10 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 926 | Opt | 0.06 | 926.1 | 0 | 0.0001 |
| 10 | 0.5 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1006.6 | Opt | 0.05 | 1006.6 | 0 | 0 |
| 10 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 582.76 | Opt | 0.06 | 592.73 | 0 | 0.0171 |
| 10 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 753.01 | Opt | 0.06 | 753.01 | 0.01 | 0 |
| 10 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 534.37 | Opt | 0.06 | 534.37 | 0 | 0 |
| 10 | 0.5 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 634.64 | Opt | 0.06 | 634.64 | 0 | 0 |
| 10 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 2 | 18 | 30 | 786.13 | Opt | 0.06 | 786.05 | 0 | -1E-04 |
| 10 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 856.29 | Opt | 0.06 | 856.3 | 0.01 | 2E-06 |
| 10 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 767.67 | Opt | 0.061 | 767.67 | 0.01 | 0 |
| 10 | 0.5 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 827.9 | Opt | 0.06 | 827.9 | 0 | 0 |
| 10 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 752.48 | Opt | 0.06 | 752.48 | 0 | 0 |
| 10 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 703.91 | Opt | 0.06 | 703.91 | 0 | 0 |
| 10 | 0.5 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 934.06 | Opt | 0.05 | 934.06 | 0.01 | 4E-06 |
| 10 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 1 | 5 | 44 | 935.46 | Opt | 0.06 | 935.41 | 0 | -5E-05 |
| 10 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 926.8 | Opt | 0.06 | 926.8 | 0 | 0 |
| 10 | 0.5 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1007 | Opt | 0.04 | 1007 | 0.01 | 0 |
| 10 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 583.19 | Opt | 0.06 | 593.1 | 0 | 0.017 |
| 10 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 753.25 | Opt | 0.06 | 753.27 | 0.01 | 2E-05 |
| 10 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 535.42 | Opt | 0.061 | 535.42 | 0 | 0 |
| 10 | 0.5 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 635.52 | Opt | 0.06 | 635.52 | 0 | 0 |
| 10 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 786.94 | Opt | 0.06 | 786.95 | 0.01 | 1E-05 |
| 10 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 857.02 | Opt | 0.06 | 857.04 | 0 | 2E-05 |
| 10 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 769.24 | Opt | 0.06 | 769.24 | 0 | 0 |
| 10 | 0.5 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 829.26 | Opt | 0.06 | 829.26 | 0 | 0 |
| 10 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 752.66 | Opt | 0.06 | 752.68 | 0 | 2E-05 |
| 10 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 704.51 | Opt | 0.06 | 704.51 | 0 | 0 |
| 10 | 0.5 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 934.25 | Opt | 0.06 | 934.27 | 0 | 2E-05 |
| 10 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 935.78 | Opt | 0.06 | 935.8 | 0.01 | 2E-05 |
| 10 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0.01 | 0 |
| 10 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 927.51 | Opt | 0.06 | 927.51 | 0 | 0 |
| 10 | 0.5 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1007.4 | Opt | 0.041 | 1007.4 | 0.01 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 10 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 32 | 13 | 582.82 | Opt | 0.06 | 593.13 | 0 | 0.0177 |
| 10 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 753.67 | Opt | 0.07 | 753.73 | 0 | 9E-05 |
| 10 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 1 | 45 | 4 | 534.12 | Opt | 0.06 | 534.22 | 0 | 0.0002 |
| 10 | 0.5 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 634.91 | Opt | 0.06 | 634.91 | 0 | 0 |
| 10 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 785.89 | Opt | 0.06 | 786.82 | 0.01 | 0.0012 |
| 10 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 856.63 | Opt | 0.07 | 857.43 | 0 | 0.0009 |
| 10 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 767.63 | Opt | 0.2 | 767.87 | 0 | 0.0003 |
| 10 | 0.5 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 828.32 | Opt | 0.211 | 828.57 | 0 | 0.0003 |
| 10 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 752.76 | Opt | 0.06 | 752.76 | 0 | 0 |
| 10 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 703.87 | Opt | 0.06 | 703.87 | 0 | 0 |
| 10 | 0.5 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 934.73 | Opt | 0.06 | 934.74 | 0 | 6E-06 |
| 10 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 935.58 | Opt | 0.06 | 936.1 | 0 | 0.0006 |
| 10 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 927.1 | Opt | 0.06 | 927.29 | 0.01 | 0.0002 |
| 10 | 0.5 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1008 | Opt | 0.04 | 1008 | 0.01 | 0 |
| 10 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 4 | 34 | 12 | 583.47 | Opt | 0.06 | 593.5 | 0 | 0.0172 |
| 10 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 753.98 | Opt | 0.07 | 753.99 | 0 | 1E-05 |
| 10 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 535.27 | Opt | 0.061 | 535.27 | 0 | 0 |
| 10 | 0.5 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 635.79 | Opt | 0.06 | 635.79 | 0 | 0 |
| 10 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 787.5 | Opt | 0.07 | 787.72 | 0 | 0.0003 |
| 10 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 857.99 | Opt | 0.06 | 858.17 | 0.01 | 0.0002 |
| 10 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 769.41 | Opt | 0.09 | 769.44 | 0 | 3E-05 |
| 10 | 0.5 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 829.9 | Opt | 0.07 | 829.93 | 0.01 | 3E-05 |
| 10 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 752.96 | Opt | 0.06 | 752.96 | 0.01 | 0 |
| 10 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0.01 | 0 |
| 10 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 704.47 | Opt | 0.06 | 704.47 | 0 | 0 |
| 10 | 0.5 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 934.94 | Opt | 0.06 | 934.94 | 0.01 | 0 |
| 10 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 936.39 | Opt | 0.061 | 936.5 | 0 | 0.0001 |
| 10 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 927.99 | Opt | 0.07 | 927.99 | 0 | 0 |
| 10 | 0.5 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1008.4 | Opt | 0.06 | 1008.4 | 0 | 0 |
| 10 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 583.95 | Opt | 0.06 | 593.87 | 0 | 0.017 |
| 10 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 754.25 | Opt | 0.07 | 754.25 | 0 | 0 |
| 10 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 536.32 | Opt | 0.06 | 536.32 | 0 | 0 |
| 10 | 0.5 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 636.67 | Opt | 0.06 | 636.67 | 0.01 | 0 |
| 10 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 788.63 | Opt | 0.07 | 788.63 | 0 | 0 |
| 10 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 858.91 | Opt | 0.06 | 858.92 | 0.01 | 5E-06 |
| 10 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 771.01 | Opt | 0.06 | 771.01 | 0 | 0 |
| 10 | 0.5 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 831.28 | Opt | 0.061 | 831.28 | 0.01 | 0 |
| 10 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 753.16 | Opt | 0.06 | 753.16 | 0 | 0 |
| 10 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 705.07 | Opt | 0.06 | 705.07 | 0 | 0 |
| 10 | 0.5 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 935.15 | Opt | 0.06 | 935.15 | 0 | 6E-06 |
| 10 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 936.88 | Opt | 0.06 | 936.89 | 0.01 | 1E-05 |
| 10 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0.01 | 0 |
| 10 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 928.7 | Opt | 0.07 | 928.7 | 0 | 0 |
| 10 | 0.5 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1008.8 | Opt | 0.06 | 1008.8 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 10 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 4 | 34 | 12 | 583.81 | Opt | 0.07 | 593.95 | 0 | 0.0174 |
| 10 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 754.49 | Opt | 0.07 | 754.53 | 0 | 5E-05 |
| 10 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 1 | 45 | 4 | 535.69 | Opt | 0.06 | 535.75 | 0 | 0.0001 |
| 10 | 1 | 1 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 636.38 | Opt | 0.061 | 636.38 | 0 | 0 |
| 10 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 788.14 | Opt | 0.07 | 788.61 | 0 | 0.0006 |
| 10 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 858.82 | Opt | 0.07 | 859.23 | 0 | 0.0005 |
| 10 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 770.3 | Opt | 0.08 | 770.43 | 0 | 0.0002 |
| 10 | 1 | 1 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 830.95 | Opt | 0.07 | 831.08 | 0.01 | 0.0002 |
| 10 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 754.06 | Opt | 0.06 | 754.06 | 0 | 3E-06 |
| 10 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 706.05 | Opt | 0.06 | 706.05 | 0 | 0 |
| 10 | 1 | 1 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 936.82 | Opt | 0.06 | 936.82 | 0.01 | 5E-06 |
| 10 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 938.68 | Opt | 0.06 | 938.95 | 0 | 0.0003 |
| 10 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 930.89 | Opt | 0.07 | 931 | 0 | 0.0001 |
| 10 | 1 | 1 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1011.7 | Opt | 0.04 | 1011.7 | 0 | 0 |
| 10 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 584.34 | Opt | 0.08 | 594.32 | 0 | 0.0171 |
| 10 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 754.79 | Opt | 0.07 | 754.79 | 0 | 8E-06 |
| 10 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 536.8 | Opt | 0.06 | 536.8 | 0 | 0 |
| 10 | 1 | 1 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 637.25 | Opt | 0.06 | 637.25 | 0 | 0 |
| 10 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 789.51 | Opt | 0.06 | 789.52 | 0.01 | 5E-06 |
| 10 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 859.97 | Opt | 0.06 | 859.97 | 0.01 | 3E-06 |
| 10 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 772 | Opt | 0.06 | 772 | 0 | 0 |
| 10 | 1 | 1 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 832.43 | Opt | 0.06 | 832.43 | 0 | 0 |
| 10 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 754.26 | Opt | 0.07 | 754.26 | 0 | 5E-06 |
| 10 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 706.65 | Opt | 0.061 | 706.65 | 0 | 0 |
| 10 | 1 | 1 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 937.03 | Opt | 0.06 | 937.03 | 0.01 | 4E-06 |
| 10 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 1 | 5 | 44 | 939.39 | Opt | 0.06 | 939.35 | 0 | -5E-05 |
| 10 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 931.71 | Opt | 0.06 | 931.71 | 0 | 0 |
| 10 | 1 | 1 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1012.1 | Opt | 0.04 | 1012.1 | 0 | 0 |
| 10 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 584.76 | Opt | 0.09 | 594.69 | 0 | 0.017 |
| 10 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 755.03 | Opt | 0.351 | 755.05 | 0 | 3E-05 |
| 10 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 537.85 | Opt | 0.06 | 537.85 | 0 | 0 |
| 10 | 1 | 1 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 638.13 | Opt | 0.06 | 638.13 | 0 | 0 |
| 10 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 790.41 | Opt | 0.07 | 790.42 | 0 | 2E-05 |
| 10 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 860.7 | Opt | 0.07 | 860.71 | 0 | 2E-05 |
| 10 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 773.57 | Opt | 0.06 | 773.57 | 0 | 0 |
| 10 | 1 | 1 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 833.78 | Opt | 0.06 | 833.78 | 0 | 0 |
| 10 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 754.45 | Opt | 0.05 | 754.47 | 0 | 2E-05 |
| 10 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 707.26 | Opt | 0.05 | 707.26 | 0.01 | 0 |
| 10 | 1 | 1 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 937.22 | Opt | 0.05 | 937.24 | 0 | 2E-05 |
| 10 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 939.71 | Opt | 0.071 | 939.73 | 0 | 2E-05 |
| 10 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 932.42 | Opt | 0.05 | 932.42 | 0.01 | 0 |
| 10 | 1 | 1 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1012.5 | Opt | 0.04 | 1012.5 | 0 | 0 |

| Input Parameters | | | | | | | | | Output | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1$ | $d_2$ | $d_0$ | $d_{-1}$ | (0,0) | (1,0) | (1,1) | Opt obj | Status | Opt sol time | H obj | H sol time | H-Opt gap |
| 10 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 5 | 32 | 13 | 584.39 | Opt | 0.05 | 594.72 | 0 | 0.0177 |
| 10 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 755.44 | Opt | 0.07 | 755.51 | 0 | 9E-05 |
| 10 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 1 | 45 | 4 | 536.54 | Opt | 0.06 | 536.65 | 0 | 0.0002 |
| 10 | 1 | 2 | 0 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 637.53 | Opt | 0.05 | 637.53 | 0 | 0 |
| 10 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 789.35 | Opt | 0.05 | 790.29 | 0 | 0.0012 |
| 10 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 860.3 | Opt | 0.06 | 861.11 | 0 | 0.0009 |
| 10 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 771.94 | Opt | 0.19 | 772.2 | 0 | 0.0003 |
| 10 | 1 | 2 | 0 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 832.83 | Opt | 0.181 | 833.1 | 0 | 0.0003 |
| 10 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 754.55 | Opt | 0.07 | 754.55 | 0 | 0 |
| 10 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.03 | 0 | 0 | 0 |
| 10 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 706.61 | Opt | 0.06 | 706.61 | 0.01 | 0 |
| 10 | 1 | 2 | 0 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 937.7 | Opt | 0.07 | 937.7 | 0 | 7E-06 |
| 10 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 939.5 | Opt | 0.08 | 940.04 | 0 | 0.0006 |
| 10 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 931.99 | Opt | 0.08 | 932.19 | 0 | 0.0002 |
| 10 | 1 | 2 | 0 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1013.1 | Opt | 0.06 | 1013.1 | 0 | 0 |
| 10 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 4 | 34 | 12 | 585.05 | Opt | 0.061 | 595.09 | 0 | 0.0172 |
| 10 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 1 | 23 | 26 | 755.76 | Opt | 0.07 | 755.77 | 0 | 2E-05 |
| 10 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 537.7 | Opt | 0.06 | 537.7 | 0 | 0 |
| 10 | 1 | 2 | 1.5 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 638.4 | Opt | 0.06 | 638.4 | 0 | 0 |
| 10 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 5 | 12 | 33 | 790.97 | Opt | 0.06 | 791.19 | 0 | 0.0003 |
| 10 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 4 | 7 | 39 | 861.66 | Opt | 0.07 | 861.85 | 0 | 0.0002 |
| 10 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 22 | 27 | 773.73 | Opt | 0.07 | 773.77 | 0 | 5E-05 |
| 10 | 1 | 2 | 1.5 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 1 | 16 | 33 | 834.42 | Opt | 0.07 | 834.46 | 0 | 5E-05 |
| 10 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 754.75 | Opt | 0.06 | 754.75 | 0 | 0 |
| 10 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 707.21 | Opt | 0.07 | 707.21 | 0 | 0 |
| 10 | 1 | 2 | 1.5 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 937.91 | Opt | 0.061 | 937.91 | 0 | 0 |
| 10 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 3 | 1 | 46 | 940.31 | Opt | 0.06 | 940.43 | 0 | 0.0001 |
| 10 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.01 | 0 | 0 | 0 |
| 10 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 1 | 6 | 43 | 932.87 | Opt | 0.06 | 932.9 | 0 | 3E-05 |
| 10 | 1 | 2 | 1.5 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1013.6 | Opt | 0.05 | 1013.6 | 0 | 0 |
| 10 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 1 | 40 | 9 | 585.52 | Opt | 0.06 | 595.46 | 0.01 | 0.017 |
| 10 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 0 | 25 | 25 | 756.03 | Opt | 0.06 | 756.03 | 0.01 | 0 |
| 10 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 47 | 3 | 538.75 | Opt | 0.06 | 538.75 | 0 | 0 |
| 10 | 1 | 2 | 3 | 0.75 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 37 | 13 | 639.28 | Opt | 0.06 | 639.28 | 0 | 0 |
| 10 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 22 | 28 | 792.1 | Opt | 0.07 | 792.1 | 0 | 0 |
| 10 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 0 | 15 | 35 | 862.59 | Opt | 0.07 | 862.59 | 0 | 7E-06 |
| 10 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 24 | 26 | 775.34 | Opt | 0.07 | 775.34 | 0 | 0 |
| 10 | 1 | 2 | 3 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 18 | 32 | 835.81 | Opt | 0.061 | 835.81 | 0 | 0 |
| 10 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0,0.01] | 0 | 25 | 25 | 754.95 | Opt | 0.06 | 754.95 | 0 | 0 |
| 10 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.02 | 0 | 0 | 0 |
| 10 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0,0.01] | 0 | 30 | 20 | 707.82 | Opt | 0.06 | 707.82 | 0 | 0 |
| 10 | 1 | 2 | 3 | 0.85 | [0,0.05] | [0,0.05] | [0.05,0.1] | [0.01,0.02] | 0 | 7 | 43 | 938.12 | Opt | 0.07 | 938.12 | 0 | 7E-06 |
| 10 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0,0.01] | 0 | 7 | 43 | 940.81 | Opt | 0.07 | 940.83 | 0 | 1E-05 |
| 10 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0,0.05] | [0.01,0.02] | 50 | 0 | 0 | 0 | Inf | 0.03 | 0 | 0 | 0 |
| 10 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0,0.01] | 0 | 8 | 42 | 933.61 | Opt | 0.07 | 933.61 | 0 | 0 |
| 10 | 1 | 2 | 3 | 0.85 | [0.05,0.1] | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | 0 | 0 | 50 | 1014 | Opt | 0.06 | 1014 | 0 | 0 |

## Appendix I – Results for Multiple Pool Inventory Sharing with Dedicated Facilities

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 2 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 3 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 4 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 5 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 6 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 7 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 8 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 9 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 10 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 11 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 12 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 13 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 14 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 15 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 16 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 17 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 18 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 19 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 20 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 21 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 22 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 23 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 24 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 25 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 26 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 27 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 28 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 29 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 30 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 31 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 32 | 10 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 33 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 34 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 35 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 36 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 37 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 38 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 39 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 40 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 41 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 42 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 43 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 44 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 45 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 46 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 47 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 48 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 1 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | Opt | 0.17 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | 0.01 | 0 |
| 2 | 0 | 10 | 0 | 0 | 105.1 | 0.714 | Opt | 0.201 | 0 | 10 | 0 | 3 | 109.6 | 0.7017 | 0.01 | 0.04283 |
| 3 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | Opt | 0.08 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | 0 | 0 |
| 4 | 0 | 8 | 2 | 0 | 126.1 | 0.7059 | Opt | 0.09 | 0 | 7 | 3 | 0 | 136.6 | 0.7144 | 0.01 | 0.08325 |
| 5 | 1 | 9 | 0 | 0 | 94.73 | 0.7276 | Opt | 0.08 | 1 | 9 | 0 | 0 | 94.73 | 0.7276 | 0 | 2.3E-05 |
| 6 | 1 | 9 | 0 | 0 | 94.74 | 0.7231 | Opt | 0.07 | 1 | 9 | 0 | 0 | 94.74 | 0.7111 | 0.01 | 3.6E-05 |
| 7 | 0 | 10 | 0 | 0 | 105.1 | 0.7378 | Opt | 0.09 | 0 | 10 | 0 | 0 | 105.1 | 0.7378 | 0.01 | 0 |
| 8 | 0 | 10 | 0 | 0 | 105.1 | 0.7358 | Opt | 0.08 | 0 | 10 | 0 | 0 | 105.1 | 0.7242 | 0.01 | 1.9E-05 |
| 9 | 0 | 7 | 3 | 0 | 136.6 | 0.7084 | Opt | 0.091 | 0 | 7 | 3 | 0 | 136.6 | 0.7084 | 0.01 | 0 |
| 10 | 0 | 7 | 3 | 0 | 136.7 | 0.7088 | Opt | 0.1 | 0 | 7 | 3 | 1 | 138.2 | 0.7005 | 0 | 0.01098 |
| 11 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | Opt | 0.09 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | 0 | 0 |
| 12 | 0 | 6 | 4 | 0 | 147.2 | 0.7105 | Opt | 0.11 | 0 | 6 | 4 | 0 | 147.2 | 0.7016 | 0.01 | 6.8E-06 |
| 13 | 0 | 8 | 2 | 0 | 126.2 | 0.7188 | Opt | 0.09 | 0 | 8 | 2 | 0 | 126.2 | 0.7188 | 0 | 0 |
| 14 | 0 | 8 | 2 | 0 | 126.2 | 0.7182 | Opt | 0.1 | 0 | 8 | 2 | 0 | 126.2 | 0.7105 | 0 | 1.6E-05 |
| 15 | 0 | 7 | 3 | 0 | 136.7 | 0.7222 | Opt | 0.1 | 0 | 7 | 3 | 0 | 136.7 | 0.7222 | 0 | 0 |
| 16 | 0 | 7 | 3 | 0 | 136.7 | 0.7218 | Opt | 0.141 | 0 | 7 | 3 | 0 | 136.7 | 0.7144 | 0.01 | 1.5E-05 |
| 17 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.09 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0 | 0 |
| 18 | 0 | 9 | 1 | 1 | 117.1 | 0.7514 | Opt | 0.1 | 0 | 8 | 2 | 0 | 126.1 | 0.7577 | 0.01 | 0.07685 |
| 19 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.09 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0 | 0 |
| 20 | 0 | 6 | 4 | 0 | 147.1 | 0.7539 | Opt | 0.09 | 0 | 5 | 5 | 0 | 157.6 | 0.7593 | 0.01 | 0.07138 |
| 21 | 0 | 10 | 0 | 0 | 105.1 | 0.7911 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.1 | 0.7911 | 0 | 0 |
| 22 | 0 | 10 | 0 | 0 | 105.1 | 0.7871 | Opt | 0.09 | 0 | 10 | 0 | 0 | 105.1 | 0.774 | 0 | 1.9E-05 |
| 23 | 0 | 9 | 1 | 0 | 115.6 | 0.7631 | Opt | 0.091 | 0 | 9 | 1 | 0 | 115.6 | 0.7631 | 0 | 0 |
| 24 | 0 | 9 | 1 | 0 | 115.6 | 0.7608 | Opt | 0.12 | 0 | 9 | 1 | 2 | 118.6 | 0.7507 | 0.01 | 0.02595 |
| 25 | 0 | 6 | 4 | 0 | 147.1 | 0.7508 | Opt | 0.09 | 0 | 6 | 4 | 0 | 147.1 | 0.7508 | 0 | 0 |
| 26 | 0 | 6 | 4 | 1 | 148.6 | 0.7503 | Opt | 0.1 | 0 | 5 | 5 | 0 | 157.6 | 0.7757 | 0 | 0.06049 |
| 27 | 0 | 4 | 6 | 0 | 168.1 | 0.7809 | Opt | 6.86 | 0 | 4 | 6 | 0 | 168.1 | 0.7809 | 0.01 | 0 |
| 28 | 0 | 5 | 5 | 5 | 165.1 | 0.7501 | Opt | 0.32 | 0 | 4 | 6 | 0 | 168.1 | 0.7691 | 0 | 0.01812 |
| 29 | 0 | 7 | 3 | 0 | 136.7 | 0.755 | Opt | 0.091 | 0 | 7 | 3 | 0 | 136.7 | 0.755 | 0 | 0 |
| 30 | 0 | 7 | 3 | 0 | 136.7 | 0.7539 | Opt | 0.09 | 0 | 6 | 4 | 0 | 147.2 | 0.7795 | 0.01 | 0.07671 |
| 31 | 0 | 6 | 4 | 0 | 147.2 | 0.7558 | Opt | 0.09 | 0 | 6 | 4 | 0 | 147.2 | 0.7558 | 0 | 0 |
| 32 | 0 | 6 | 4 | 0 | 147.2 | 0.7544 | Opt | 0.09 | 0 | 5 | 5 | 0 | 157.7 | 0.7753 | 0.01 | 0.07124 |
| 33 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | 0 | 0 |
| 34 | 0 | 10 | 0 | 0 | 105.1 | 0.714 | Opt | 0.14 | 0 | 10 | 0 | 3 | 109.6 | 0.7017 | 0 | 0.04282 |
| 35 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | Opt | 0.09 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | 0 | 0 |
| 36 | 0 | 8 | 2 | 0 | 126.1 | 0.7059 | Opt | 0.101 | 0 | 7 | 3 | 0 | 136.6 | 0.7144 | 0 | 0.08321 |
| 37 | 1 | 9 | 0 | 0 | 94.89 | 0.7276 | Opt | 0.09 | 1 | 9 | 0 | 0 | 94.89 | 0.7276 | 0 | 4.6E-05 |
| 38 | 1 | 9 | 0 | 0 | 94.91 | 0.7231 | Opt | 0.09 | 1 | 9 | 0 | 0 | 94.91 | 0.7111 | 0 | 7.1E-05 |
| 39 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | Opt | 0.09 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | 0.01 | 0 |
| 40 | 0 | 10 | 0 | 0 | 105.2 | 0.7358 | Opt | 0.09 | 0 | 10 | 0 | 0 | 105.2 | 0.7242 | 0.01 | 2.9E-05 |
| 41 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | Opt | 0.1 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | 0 | 0 |
| 42 | 0 | 7 | 3 | 0 | 136.7 | 0.7088 | Opt | 0.1 | 0 | 7 | 3 | 1 | 138.2 | 0.7005 | 0.01 | 0.01099 |
| 43 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | Opt | 0.091 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | 0.01 | 0 |
| 44 | 0 | 6 | 4 | 0 | 147.2 | 0.7105 | Opt | 0.13 | 0 | 6 | 4 | 0 | 147.2 | 0.7016 | 0 | 1.4E-05 |
| 45 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | Opt | 0.1 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | 0 | 0 |
| 46 | 0 | 8 | 2 | 0 | 126.3 | 0.7182 | Opt | 0.09 | 0 | 8 | 2 | 0 | 126.3 | 0.7105 | 0 | 3.2E-05 |
| 47 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | Opt | 0.1 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | 0.01 | 0 |
| 48 | 0 | 7 | 3 | 0 | 136.8 | 0.7218 | Opt | 0.11 | 0 | 7 | 3 | 0 | 136.8 | 0.7144 | 0.01 | 2.9E-05 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 49 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 50 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 51 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 52 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 53 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 54 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 55 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 56 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 57 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 58 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 59 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 60 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 61 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 62 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 63 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 64 | 10 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 65 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 66 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 67 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 68 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 69 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 70 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 71 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 72 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 73 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 74 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 75 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 76 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 77 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 78 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 79 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 80 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 81 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 82 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 83 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 84 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 85 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 86 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 87 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 88 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 89 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 90 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 91 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 92 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 93 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 94 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 95 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 96 | 10 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 49 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.101 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0 | 0 |
| 50 | 0 | 9 | 1 | 1 | 117.1 | 0.7514 | Opt | 0.11 | 0 | 8 | 2 | 0 | 126.1 | 0.7577 | 0 | 0.07681 |
| 51 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.09 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0 | 0 |
| 52 | 0 | 6 | 4 | 0 | 147.1 | 0.7539 | Opt | 0.1 | 0 | 5 | 5 | 0 | 157.6 | 0.7593 | 0 | 0.07137 |
| 53 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | 0 | 0 |
| 54 | 0 | 10 | 0 | 0 | 105.2 | 0.7871 | Opt | 0.09 | 0 | 10 | 0 | 0 | 105.2 | 0.774 | 0.01 | 3.8E-05 |
| 55 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | Opt | 0.09 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | 0.01 | 0 |
| 56 | 0 | 9 | 1 | 0 | 115.7 | 0.7608 | Opt | 0.111 | 0 | 9 | 1 | 2 | 118.7 | 0.7507 | 0.01 | 0.02596 |
| 57 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | Opt | 0.09 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | 0.01 | 0 |
| 58 | 0 | 6 | 4 | 1 | 148.7 | 0.7503 | Opt | 0.11 | 0 | 5 | 5 | 0 | 157.7 | 0.7757 | 0 | 0.06042 |
| 59 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | Opt | 0.441 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | 0.01 | 0 |
| 60 | 0 | 5 | 5 | 5 | 165.2 | 0.75 | Opt | 1.962 | 0 | 4 | 6 | 0 | 168.2 | 0.7691 | 0 | 0.01807 |
| 61 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | Opt | 0.09 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | 0.01 | 0 |
| 62 | 0 | 7 | 3 | 0 | 136.8 | 0.7539 | Opt | 0.091 | 0 | 6 | 4 | 0 | 147.3 | 0.7795 | 0 | 0.07658 |
| 63 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | Opt | 0.1 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | 0.01 | 0 |
| 64 | 0 | 6 | 4 | 0 | 147.3 | 0.7544 | Opt | 0.1 | 0 | 5 | 5 | 0 | 157.8 | 0.7753 | 0 | 0.07111 |
| 65 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | 0 | 0 |
| 66 | 0 | 10 | 0 | 0 | 105.1 | 0.714 | Opt | 0.17 | 0 | 10 | 0 | 3 | 109.6 | 0.7017 | 0 | 0.04282 |
| 67 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | Opt | 0.1 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | 0 | 0 |
| 68 | 0 | 8 | 2 | 0 | 126.1 | 0.7059 | Opt | 0.101 | 0 | 7 | 3 | 0 | 136.6 | 0.7144 | 0 | 0.08322 |
| 69 | 1 | 9 | 0 | 0 | 94.75 | 0.7276 | Opt | 0.09 | 1 | 9 | 0 | 0 | 94.75 | 0.7276 | 0.01 | 2.3E-05 |
| 70 | 1 | 9 | 0 | 0 | 94.76 | 0.7231 | Opt | 0.1 | 1 | 9 | 0 | 0 | 94.76 | 0.7111 | 0 | 3.6E-05 |
| 71 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | 0 | 0 |
| 72 | 0 | 10 | 0 | 0 | 105.2 | 0.7358 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.2 | 0.7242 | 0.01 | 1.9E-05 |
| 73 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | Opt | 0.11 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | 0.01 | 0 |
| 74 | 0 | 7 | 3 | 0 | 136.7 | 0.7088 | Opt | 0.1 | 0 | 7 | 3 | 1 | 138.2 | 0.7005 | 0.01 | 0.01098 |
| 75 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | Opt | 0.11 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | 0.011 | 0 |
| 76 | 0 | 6 | 4 | 0 | 147.2 | 0.7105 | Opt | 0.1 | 0 | 6 | 4 | 0 | 147.2 | 0.7016 | 0.01 | 6.8E-06 |
| 77 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | Opt | 0.1 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | 0.01 | 0 |
| 78 | 0 | 8 | 2 | 0 | 126.3 | 0.7182 | Opt | 0.1 | 0 | 8 | 2 | 0 | 126.3 | 0.7105 | 0 | 1.6E-05 |
| 79 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | Opt | 0.1 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | 0.01 | 0 |
| 80 | 0 | 7 | 3 | 0 | 136.8 | 0.7218 | Opt | 0.141 | 0 | 7 | 3 | 0 | 136.8 | 0.7144 | 0.01 | 1.5E-05 |
| 81 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.1 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0 | 0 |
| 82 | 0 | 9 | 1 | 1 | 117.1 | 0.7514 | Opt | 0.11 | 0 | 8 | 2 | 0 | 126.1 | 0.7577 | 0 | 0.07682 |
| 83 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.09 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0.01 | 0 |
| 84 | 0 | 6 | 4 | 0 | 147.1 | 0.7539 | Opt | 0.1 | 0 | 5 | 5 | 0 | 157.6 | 0.7593 | 0 | 0.07136 |
| 85 | 0 | 10 | 0 | 0 | 105.1 | 0.7911 | Opt | 0.09 | 0 | 10 | 0 | 0 | 105.1 | 0.7911 | 0.01 | 0 |
| 86 | 0 | 10 | 0 | 0 | 105.2 | 0.7871 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.2 | 0.774 | 0.01 | 9.5E-06 |
| 87 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | Opt | 0.101 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | 0 | 0 |
| 88 | 0 | 9 | 1 | 0 | 115.7 | 0.7608 | Opt | 0.12 | 0 | 9 | 1 | 2 | 118.7 | 0.7507 | 0.01 | 0.02595 |
| 89 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | Opt | 0.09 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | 0 | 0 |
| 90 | 0 | 6 | 4 | 1 | 148.7 | 0.7503 | Opt | 0.11 | 0 | 5 | 5 | 0 | 157.7 | 0.7757 | 0.01 | 0.06044 |
| 91 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | Opt | 0.981 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | 0.01 | 0 |
| 92 | 0 | 5 | 5 | 5 | 165.2 | 0.7501 | Opt | 0.641 | 0 | 4 | 6 | 0 | 168.2 | 0.7691 | 0 | 0.01809 |
| 93 | 0 | 7 | 3 | 0 | 136.7 | 0.755 | Opt | 0.101 | 0 | 7 | 3 | 0 | 136.7 | 0.755 | 0 | 0 |
| 94 | 0 | 7 | 3 | 0 | 136.7 | 0.7539 | Opt | 0.1 | 0 | 6 | 4 | 0 | 147.2 | 0.7795 | 0 | 0.07665 |
| 95 | 0 | 6 | 4 | 0 | 147.2 | 0.7558 | Opt | 0.1 | 0 | 6 | 4 | 0 | 147.2 | 0.7558 | 0.01 | 0 |
| 96 | 0 | 6 | 4 | 0 | 147.2 | 0.7544 | Opt | 0.1 | 0 | 5 | 5 | 0 | 157.7 | 0.7753 | 0.01 | 0.07119 |

| | Input Parameters | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 97 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 98 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 99 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 100 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 101 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 102 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 103 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 104 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 105 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 106 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 107 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 108 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 109 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 110 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 111 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 112 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 113 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 114 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 115 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 116 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 117 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 118 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 119 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 120 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 121 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 122 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 123 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 124 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 125 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 126 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 127 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 128 | 10 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 129 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 130 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 131 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 132 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 133 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 134 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 135 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 136 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 137 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 138 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 139 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 140 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 141 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 142 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 143 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 144 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 97 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | 0 | 0 |
| 98 | 0 | 10 | 0 | 0 | 105.1 | 0.714 | Opt | 0.13 | 0 | 10 | 0 | 3 | 109.6 | 0.7017 | 0.01 | 0.04281 |
| 99 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | Opt | 0.1 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | 0 | 0 |
| 100 | 0 | 8 | 2 | 0 | 126.1 | 0.7059 | Opt | 0.111 | 0 | 7 | 3 | 0 | 136.6 | 0.7144 | 0 | 0.08318 |
| 101 | 1 | 9 | 0 | 0 | 94.91 | 0.7276 | Opt | 0.1 | 1 | 9 | 0 | 0 | 94.91 | 0.7276 | 0 | 4.6E-05 |
| 102 | 1 | 9 | 0 | 0 | 94.93 | 0.7231 | Opt | 0.1 | 1 | 9 | 0 | 0 | 94.92 | 0.7111 | 0.01 | 7.1E-05 |
| 103 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | 0 | 0 |
| 104 | 0 | 10 | 0 | 0 | 105.2 | 0.7358 | Opt | 0.11 | 0 | 10 | 0 | 0 | 105.2 | 0.7242 | 0 | 2.9E-05 |
| 105 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | Opt | 0.1 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | 0 | 0 |
| 106 | 0 | 7 | 3 | 0 | 136.7 | 0.7088 | Opt | 0.111 | 0 | 7 | 3 | 1 | 138.2 | 0.7005 | 0 | 0.01098 |
| 107 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | Opt | 0.1 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | 0 | 0 |
| 108 | 0 | 6 | 4 | 0 | 147.2 | 0.7105 | Opt | 0.13 | 0 | 6 | 4 | 0 | 147.2 | 0.7016 | 0 | 2E-05 |
| 109 | 0 | 8 | 2 | 0 | 126.4 | 0.7188 | Opt | 0.1 | 0 | 8 | 2 | 0 | 126.4 | 0.7188 | 0 | 0 |
| 110 | 0 | 8 | 2 | 0 | 126.4 | 0.7182 | Opt | 0.11 | 0 | 8 | 2 | 0 | 126.4 | 0.7105 | 0.01 | 3.2E-05 |
| 111 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | Opt | 0.11 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | 0.01 | 0 |
| 112 | 0 | 7 | 3 | 0 | 136.9 | 0.7218 | Opt | 0.141 | 0 | 7 | 3 | 0 | 136.9 | 0.7144 | 0 | 2.2E-05 |
| 113 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.1 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0 | 0 |
| 114 | 0 | 9 | 1 | 1 | 117.1 | 0.7514 | Opt | 0.11 | 0 | 8 | 2 | 0 | 126.1 | 0.7577 | 0.01 | 0.07679 |
| 115 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.1 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0 | 0 |
| 116 | 0 | 6 | 4 | 0 | 147.1 | 0.7539 | Opt | 0.1 | 0 | 5 | 5 | 0 | 157.6 | 0.7593 | 0.01 | 0.07135 |
| 117 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | Opt | 0.11 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | 0 | 0 |
| 118 | 0 | 10 | 0 | 0 | 105.2 | 0.7871 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.2 | 0.774 | 0 | 2.9E-05 |
| 119 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | Opt | 0.111 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | 0 | 0 |
| 120 | 0 | 9 | 1 | 0 | 115.7 | 0.7608 | Opt | 0.13 | 0 | 9 | 1 | 2 | 118.7 | 0.7507 | 0 | 0.02594 |
| 121 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | Opt | 0.1 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | 0 | 0 |
| 122 | 0 | 6 | 4 | 1 | 148.7 | 0.7503 | Opt | 0.11 | 0 | 5 | 5 | 0 | 157.7 | 0.7757 | 0.01 | 0.06038 |
| 123 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | Opt | 0.251 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | 0.01 | 0 |
| 124 | 0 | 5 | 5 | 5 | 165.2 | 0.75 | Opt | 1.311 | 0 | 4 | 6 | 0 | 168.2 | 0.7691 | 0.01 | 0.01804 |
| 125 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | Opt | 0.101 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | 0 | 0 |
| 126 | 0 | 7 | 3 | 0 | 136.8 | 0.7539 | Opt | 0.1 | 0 | 6 | 4 | 0 | 147.3 | 0.7795 | 0.01 | 0.07653 |
| 127 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | Opt | 0.11 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | 0 | 0 |
| 128 | 0 | 6 | 4 | 0 | 147.3 | 0.7544 | Opt | 0.11 | 0 | 5 | 5 | 0 | 157.8 | 0.7753 | 0 | 0.07107 |
| 129 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | 0.01 | 0 |
| 130 | 0 | 10 | 0 | 0 | 105.1 | 0.714 | Opt | 0.14 | 0 | 10 | 0 | 3 | 109.6 | 0.7017 | 0 | 0.0428 |
| 131 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | Opt | 0.101 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | 0 | 0 |
| 132 | 0 | 8 | 2 | 0 | 126.1 | 0.7059 | Opt | 0.11 | 0 | 7 | 3 | 0 | 136.6 | 0.7144 | 0.01 | 0.0832 |
| 133 | 1 | 9 | 0 | 0 | 94.8 | 0.7276 | Opt | 0.1 | 1 | 9 | 0 | 0 | 94.8 | 0.7276 | 0.01 | 2.3E-05 |
| 134 | 1 | 9 | 0 | 0 | 94.81 | 0.7231 | Opt | 0.11 | 1 | 9 | 0 | 0 | 94.81 | 0.7111 | 0 | 3.6E-05 |
| 135 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | Opt | 0.12 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | 0 | 0 |
| 136 | 0 | 10 | 0 | 0 | 105.2 | 0.7358 | Opt | 0.1 | 0 | 10 | 0 | 0 | 105.2 | 0.7242 | 0.01 | 1.9E-05 |
| 137 | 0 | 7 | 3 | 0 | 136.8 | 0.7084 | Opt | 0.111 | 0 | 7 | 3 | 0 | 136.8 | 0.7084 | 0.01 | 0 |
| 138 | 0 | 7 | 3 | 0 | 136.8 | 0.7088 | Opt | 0.12 | 0 | 7 | 3 | 1 | 138.3 | 0.7005 | 0.01 | 0.01098 |
| 139 | 0 | 6 | 4 | 0 | 147.3 | 0.7106 | Opt | 0.1 | 0 | 6 | 4 | 0 | 147.3 | 0.7106 | 0 | 0 |
| 140 | 0 | 6 | 4 | 0 | 147.3 | 0.7105 | Opt | 0.13 | 0 | 6 | 4 | 0 | 147.3 | 0.7016 | 0.01 | 6.8E-06 |
| 141 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | Opt | 0.1 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | 0 | 0 |
| 142 | 0 | 8 | 2 | 0 | 126.4 | 0.7182 | Opt | 0.11 | 0 | 8 | 2 | 0 | 126.4 | 0.7105 | 0 | 1.6E-05 |
| 143 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | Opt | 0.121 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | 0 | 0 |
| 144 | 0 | 7 | 3 | 0 | 136.9 | 0.7218 | Opt | 0.12 | 0 | 7 | 3 | 0 | 136.9 | 0.7144 | 0.01 | 7.3E-06 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^e$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 145 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 146 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 147 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 148 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 149 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 150 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 151 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 152 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 153 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 154 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 155 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 156 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 157 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 158 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 159 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 160 | 10 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 161 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 162 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 163 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 164 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 165 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 166 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 167 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 168 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 169 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 170 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 171 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 172 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 173 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 174 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 175 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 176 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 177 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 178 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 179 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 180 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 181 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 182 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 183 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 184 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 185 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 186 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 187 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 188 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 189 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 190 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 191 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 192 | 10 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 145 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.1 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0.01 | 0 |
| 146 | 0 | 9 | 1 | 1 | 117.1 | 0.7514 | Opt | 0.12 | 0 | 8 | 2 | 0 | 126.1 | 0.7577 | 0.01 | 0.07681 |
| 147 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.11 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0 | 0 |
| 148 | 0 | 6 | 4 | 0 | 147.1 | 0.7539 | Opt | 0.1 | 0 | 5 | 5 | 0 | 157.6 | 0.7593 | 0 | 0.07135 |
| 149 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | Opt | 0.111 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | 0.01 | 0 |
| 150 | 0 | 10 | 0 | 0 | 105.2 | 0.7871 | Opt | 0.11 | 0 | 10 | 0 | 0 | 105.2 | 0.774 | 0 | 1.9E-05 |
| 151 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | Opt | 0.11 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | 0 | 0 |
| 152 | 0 | 9 | 1 | 0 | 115.7 | 0.7608 | Opt | 0.13 | 0 | 9 | 1 | 2 | 118.7 | 0.7507 | 0 | 0.02593 |
| 153 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | Opt | 0.1 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | 0.01 | 0 |
| 154 | 0 | 6 | 4 | 1 | 148.7 | 0.7503 | Opt | 0.12 | 0 | 5 | 5 | 0 | 157.7 | 0.7757 | 0.01 | 0.06044 |
| 155 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | Opt | 6.9 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | 0 | 0 |
| 156 | 0 | 5 | 5 | 5 | 165.3 | 0.7501 | Opt | 0.301 | 0 | 4 | 6 | 0 | 168.2 | 0.7691 | 0 | 0.0181 |
| 157 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | Opt | 0.1 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | 0.01 | 0 |
| 158 | 0 | 7 | 3 | 0 | 136.8 | 0.7539 | Opt | 0.1 | 0 | 6 | 4 | 0 | 147.3 | 0.7795 | 0.01 | 0.07663 |
| 159 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | Opt | 0.11 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | 0.01 | 0 |
| 160 | 0 | 6 | 4 | 0 | 147.3 | 0.7544 | Opt | 0.11 | 0 | 5 | 5 | 0 | 157.8 | 0.7753 | 0.01 | 0.07117 |
| 161 | 0 | 10 | 0 | 0 | 105.2 | 0.7148 | Opt | 0.111 | 0 | 10 | 0 | 0 | 105.2 | 0.7148 | 0 | 0 |
| 162 | 0 | 10 | 0 | 0 | 105.2 | 0.714 | Opt | 0.15 | 0 | 10 | 0 | 3 | 109.7 | 0.7017 | 0.01 | 0.0428 |
| 163 | 0 | 8 | 2 | 0 | 126.2 | 0.7048 | Opt | 0.11 | 0 | 8 | 2 | 0 | 126.2 | 0.7048 | 0 | 0 |
| 164 | 0 | 8 | 2 | 0 | 126.2 | 0.7059 | Opt | 0.12 | 0 | 7 | 3 | 0 | 136.7 | 0.7144 | 0.01 | 0.08316 |
| 165 | 1 | 9 | 0 | 0 | 94.96 | 0.7276 | Opt | 0.11 | 1 | 9 | 0 | 0 | 94.96 | 0.7276 | 0 | 4.6E-05 |
| 166 | 1 | 9 | 0 | 0 | 94.98 | 0.7231 | Opt | 0.11 | 1 | 9 | 0 | 0 | 94.98 | 0.7111 | 0 | 7.1E-05 |
| 167 | 0 | 10 | 0 | 0 | 105.3 | 0.7378 | Opt | 0.121 | 0 | 10 | 0 | 0 | 105.3 | 0.7378 | 0 | 0 |
| 168 | 0 | 10 | 0 | 0 | 105.3 | 0.7358 | Opt | 0.11 | 0 | 10 | 0 | 0 | 105.3 | 0.7242 | 0 | 2.8E-05 |
| 169 | 0 | 7 | 3 | 0 | 136.8 | 0.7084 | Opt | 0.12 | 0 | 7 | 3 | 0 | 136.8 | 0.7084 | 0.01 | 0 |
| 170 | 0 | 7 | 3 | 0 | 136.8 | 0.7088 | Opt | 0.13 | 0 | 7 | 3 | 1 | 138.3 | 0.7005 | 0 | 0.01098 |
| 171 | 0 | 6 | 4 | 0 | 147.3 | 0.7106 | Opt | 0.11 | 0 | 6 | 4 | 0 | 147.3 | 0.7106 | 0 | 0 |
| 172 | 0 | 6 | 4 | 0 | 147.3 | 0.7105 | Opt | 0.131 | 0 | 6 | 4 | 0 | 147.3 | 0.7016 | 0.01 | 1.4E-05 |
| 173 | 0 | 8 | 2 | 0 | 126.4 | 0.7188 | Opt | 0.11 | 0 | 8 | 2 | 0 | 126.4 | 0.7188 | 0 | 0 |
| 174 | 0 | 8 | 2 | 0 | 126.4 | 0.7159 | Opt | 0.13 | 0 | 8 | 2 | 0 | 126.5 | 0.7105 | 0 | 4.7E-05 |
| 175 | 0 | 7 | 3 | 0 | 136.9 | 0.7222 | Opt | 0.12 | 0 | 7 | 3 | 0 | 136.9 | 0.7222 | 0 | 0 |
| 176 | 0 | 7 | 3 | 0 | 136.9 | 0.7218 | Opt | 0.13 | 0 | 7 | 3 | 0 | 137 | 0.7144 | 0.01 | 2.9E-05 |
| 177 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.11 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0.01 | 0 |
| 178 | 0 | 9 | 1 | 1 | 117.2 | 0.7514 | Opt | 0.121 | 0 | 8 | 2 | 0 | 126.2 | 0.7577 | 0 | 0.07677 |
| 179 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.11 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0 | 0 |
| 180 | 0 | 6 | 4 | 0 | 147.2 | 0.7539 | Opt | 0.11 | 0 | 5 | 5 | 0 | 157.7 | 0.7593 | 0.01 | 0.07134 |
| 181 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | Opt | 0.12 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | 0 | 0 |
| 182 | 0 | 10 | 0 | 0 | 105.3 | 0.7871 | Opt | 0.12 | 0 | 10 | 0 | 0 | 105.3 | 0.774 | 0 | 3.8E-05 |
| 183 | 0 | 9 | 1 | 0 | 115.8 | 0.7631 | Opt | 0.12 | 0 | 9 | 1 | 0 | 115.8 | 0.7631 | 0 | 0 |
| 184 | 0 | 9 | 1 | 0 | 115.8 | 0.7608 | Opt | 0.141 | 0 | 9 | 1 | 2 | 118.8 | 0.7507 | 0 | 0.02593 |
| 185 | 0 | 6 | 4 | 0 | 147.3 | 0.7508 | Opt | 0.11 | 0 | 6 | 4 | 0 | 147.3 | 0.7508 | 0 | 0 |
| 186 | 0 | 6 | 4 | 1 | 148.8 | 0.7503 | Opt | 0.12 | 0 | 5 | 5 | 0 | 157.8 | 0.7757 | 0.01 | 0.06037 |
| 187 | 0 | 4 | 6 | 0 | 168.3 | 0.7809 | Opt | 0.461 | 0 | 4 | 6 | 0 | 168.3 | 0.7809 | 0.01 | 0 |
| 188 | 0 | 5 | 5 | 5 | 165.3 | 0.75 | Opt | 2.193 | 0 | 4 | 6 | 0 | 168.3 | 0.7691 | 0 | 0.01805 |
| 189 | 0 | 7 | 3 | 0 | 136.9 | 0.755 | Opt | 0.12 | 0 | 7 | 3 | 0 | 136.9 | 0.755 | 0 | 0 |
| 190 | 0 | 7 | 3 | 0 | 136.9 | 0.7539 | Opt | 0.11 | 0 | 6 | 4 | 0 | 147.4 | 0.7795 | 0 | 0.0765 |
| 191 | 0 | 6 | 4 | 0 | 147.4 | 0.7558 | Opt | 0.12 | 0 | 6 | 4 | 0 | 147.4 | 0.7558 | 0 | 0 |
| 192 | 0 | 6 | 4 | 0 | 147.4 | 0.7544 | Opt | 0.111 | 0 | 5 | 5 | 0 | 157.9 | 0.7753 | 0.01 | 0.07104 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 193 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 194 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 195 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 196 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 197 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 198 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 199 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 200 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 201 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 202 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 203 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 204 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 205 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 206 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 207 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 208 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 209 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 210 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 211 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 212 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 213 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 214 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 215 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 216 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 217 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 218 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 219 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 220 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 221 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 222 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 223 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 224 | 10 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 225 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 226 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 227 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 228 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 229 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 230 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 231 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 232 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 233 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 234 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 235 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 236 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 237 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 238 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 239 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 240 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 193 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | Opt | 0.11 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | 0.01 | 0 |
| 194 | 0 | 10 | 0 | 0 | 110.1 | 0.714 | Opt | 0.14 | 0 | 10 | 0 | 3 | 116.1 | 0.7017 | 0 | 0.05451 |
| 195 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | Opt | 0.12 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | 0 | 0 |
| 196 | 0 | 8 | 2 | 0 | 132.1 | 0.7059 | Opt | 0.12 | 0 | 7 | 3 | 0 | 143.1 | 0.7144 | 0 | 0.08326 |
| 197 | 1 | 9 | 0 | 0 | 99.23 | 0.7276 | Opt | 0.11 | 1 | 9 | 0 | 0 | 99.23 | 0.7276 | 0 | 2.2E-05 |
| 198 | 1 | 9 | 0 | 0 | 99.24 | 0.7231 | Opt | 0.111 | 1 | 9 | 0 | 0 | 99.24 | 0.7111 | 0.01 | 3.4E-05 |
| 199 | 0 | 10 | 0 | 0 | 110.1 | 0.7378 | Opt | 0.12 | 0 | 10 | 0 | 0 | 110.1 | 0.7378 | 0 | 0 |
| 200 | 0 | 10 | 0 | 0 | 110.1 | 0.7358 | Opt | 0.13 | 0 | 10 | 0 | 0 | 110.1 | 0.7242 | 0 | 1.8E-05 |
| 201 | 0 | 7 | 3 | 0 | 143.1 | 0.7084 | Opt | 0.12 | 0 | 7 | 3 | 0 | 143.1 | 0.7084 | 0 | 0 |
| 202 | 0 | 7 | 3 | 0 | 143.2 | 0.7088 | Opt | 0.13 | 0 | 7 | 3 | 1 | 145.2 | 0.7005 | 0 | 0.01397 |
| 203 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | Opt | 0.12 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | 0 | 0 |
| 204 | 0 | 6 | 4 | 0 | 154.2 | 0.7105 | Opt | 0.131 | 0 | 6 | 4 | 0 | 154.2 | 0.7016 | 0 | 6.5E-06 |
| 205 | 0 | 8 | 2 | 0 | 132.2 | 0.7188 | Opt | 0.12 | 0 | 8 | 2 | 0 | 132.2 | 0.7188 | 0 | 0 |
| 206 | 0 | 8 | 2 | 0 | 132.2 | 0.7182 | Opt | 0.13 | 0 | 8 | 2 | 0 | 132.2 | 0.7105 | 0 | 1.5E-05 |
| 207 | 0 | 7 | 3 | 0 | 143.2 | 0.7222 | Opt | 0.16 | 0 | 7 | 3 | 0 | 143.2 | 0.7222 | 0 | 0 |
| 208 | 0 | 7 | 3 | 0 | 143.2 | 0.7218 | Opt | 0.181 | 0 | 7 | 3 | 0 | 143.2 | 0.7144 | 0 | 1.4E-05 |
| 209 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.12 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0 | 0 |
| 210 | 0 | 9 | 1 | 1 | 123.1 | 0.7514 | Opt | 0.13 | 0 | 8 | 2 | 0 | 132.1 | 0.7577 | 0 | 0.07311 |
| 211 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.11 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0.01 | 0 |
| 212 | 0 | 6 | 4 | 0 | 154.1 | 0.7539 | Opt | 0.11 | 0 | 5 | 5 | 0 | 165.1 | 0.7593 | 0.01 | 0.07138 |
| 213 | 0 | 10 | 0 | 0 | 110.1 | 0.7911 | Opt | 0.12 | 0 | 10 | 0 | 0 | 110.1 | 0.7911 | 0.01 | 0 |
| 214 | 0 | 10 | 0 | 0 | 110.1 | 0.7871 | Opt | 0.121 | 0 | 10 | 0 | 0 | 110.1 | 0.774 | 0 | 1.8E-05 |
| 215 | 0 | 9 | 1 | 0 | 121.1 | 0.7631 | Opt | 0.12 | 0 | 9 | 1 | 0 | 121.1 | 0.7631 | 0 | 0 |
| 216 | 0 | 9 | 1 | 0 | 121.1 | 0.7608 | Opt | 0.13 | 0 | 9 | 1 | 2 | 125.1 | 0.7507 | 0 | 0.03303 |
| 217 | 0 | 6 | 4 | 0 | 154.1 | 0.7508 | Opt | 0.12 | 0 | 6 | 4 | 0 | 154.1 | 0.7508 | 0 | 0 |
| 218 | 0 | 6 | 4 | 1 | 156.1 | 0.7503 | Opt | 0.12 | 0 | 5 | 5 | 0 | 165.1 | 0.7757 | 0 | 0.05758 |
| 219 | 0 | 4 | 6 | 0 | 176.1 | 0.7809 | Opt | 0.681 | 0 | 4 | 6 | 0 | 176.1 | 0.7809 | 0.01 | 0 |
| 220 | 0 | 5 | 5 | 5 | 175.1 | 0.7501 | Opt | 2.234 | 0 | 4 | 6 | 0 | 176.1 | 0.7691 | 0 | 0.00566 |
| 221 | 0 | 7 | 3 | 0 | 143.2 | 0.755 | Opt | 0.11 | 0 | 7 | 3 | 0 | 143.2 | 0.755 | 0.01 | 0 |
| 222 | 0 | 7 | 3 | 0 | 143.2 | 0.7539 | Opt | 0.11 | 0 | 6 | 4 | 0 | 154.2 | 0.7795 | 0.01 | 0.07672 |
| 223 | 0 | 6 | 4 | 0 | 154.2 | 0.7558 | Opt | 0.12 | 0 | 6 | 4 | 0 | 154.2 | 0.7558 | 0.01 | 0 |
| 224 | 0 | 6 | 4 | 0 | 154.2 | 0.7544 | Opt | 0.12 | 0 | 5 | 5 | 0 | 165.2 | 0.7753 | 0 | 0.07125 |
| 225 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | Opt | 0.12 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | 0 | 0 |
| 226 | 0 | 10 | 0 | 0 | 110.1 | 0.714 | Opt | 0.131 | 0 | 10 | 0 | 3 | 116.1 | 0.7017 | 0 | 0.0545 |
| 227 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | Opt | 0.12 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | 0.01 | 0 |
| 228 | 0 | 8 | 2 | 0 | 132.1 | 0.7059 | Opt | 0.12 | 0 | 7 | 3 | 0 | 143.1 | 0.7144 | 0 | 0.08322 |
| 229 | 1 | 9 | 0 | 0 | 99.39 | 0.7276 | Opt | 0.12 | 1 | 9 | 0 | 0 | 99.39 | 0.7276 | 0.01 | 4.4E-05 |
| 230 | 1 | 9 | 0 | 0 | 99.41 | 0.7231 | Opt | 0.11 | 1 | 9 | 0 | 0 | 99.41 | 0.7111 | 0 | 6.7E-05 |
| 231 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | Opt | 0.12 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | 0 | 0 |
| 232 | 0 | 10 | 0 | 0 | 110.2 | 0.7358 | Opt | 0.131 | 0 | 10 | 0 | 0 | 110.2 | 0.7242 | 0 | 2.7E-05 |
| 233 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | Opt | 0.11 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | 0.01 | 0 |
| 234 | 0 | 7 | 3 | 0 | 143.2 | 0.7088 | Opt | 0.13 | 0 | 7 | 3 | 1 | 145.2 | 0.7005 | 0.01 | 0.01398 |
| 235 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | Opt | 0.12 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | 0 | 0 |
| 236 | 0 | 6 | 4 | 0 | 154.2 | 0.7105 | Opt | 0.13 | 0 | 6 | 4 | 0 | 154.2 | 0.7016 | 0 | 1.3E-05 |
| 237 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | Opt | 0.121 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | 0 | 0 |
| 238 | 0 | 8 | 2 | 0 | 132.3 | 0.7182 | Opt | 0.14 | 0 | 8 | 2 | 0 | 132.3 | 0.7105 | 0 | 3E-05 |
| 239 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | Opt | 0.15 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | 0 | 0 |
| 240 | 0 | 7 | 3 | 0 | 143.3 | 0.7218 | Opt | 0.13 | 0 | 7 | 3 | 0 | 143.3 | 0.7144 | 0 | 2.8E-05 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 241 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 242 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 243 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 244 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 245 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 246 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 247 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 248 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 249 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 250 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 251 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 252 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 253 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 254 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 255 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 256 | 10 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 257 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 258 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 259 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 260 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 261 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 262 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 263 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 264 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 265 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 266 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 267 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 268 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 269 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 270 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 271 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 272 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 273 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 274 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 275 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 276 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 277 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 278 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 279 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 280 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 281 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 282 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 283 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 284 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 285 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 286 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 287 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 288 | 10 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 241 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.12 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0.01 | 0 |
| 242 | 0 | 9 | 1 | 1 | 123.1 | 0.7514 | Opt | 0.131 | 0 | 8 | 2 | 0 | 132.1 | 0.7577 | 0 | 0.07307 |
| 243 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.12 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0.01 | 0 |
| 244 | 0 | 6 | 4 | 0 | 154.1 | 0.7539 | Opt | 0.12 | 0 | 5 | 5 | 0 | 165.1 | 0.7593 | 0 | 0.07137 |
| 245 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | Opt | 0.13 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | 0 | 0 |
| 246 | 0 | 10 | 0 | 0 | 110.2 | 0.7871 | Opt | 0.13 | 0 | 10 | 0 | 0 | 110.2 | 0.774 | 0 | 3.6E-05 |
| 247 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | Opt | 0.12 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | 0 | 0 |
| 248 | 0 | 9 | 1 | 0 | 121.2 | 0.7608 | Opt | 0.131 | 0 | 9 | 1 | 2 | 125.2 | 0.7507 | 0.01 | 0.03303 |
| 249 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | Opt | 0.12 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | 0 | 0 |
| 250 | 0 | 6 | 4 | 1 | 156.2 | 0.7503 | Opt | 0.14 | 0 | 5 | 5 | 0 | 165.2 | 0.7757 | 0 | 0.05752 |
| 251 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | Opt | 0.611 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | 0 | 0 |
| 252 | 0 | 5 | 5 | 5 | 175.2 | 0.75 | Opt | 2.764 | 0 | 4 | 6 | 0 | 176.2 | 0.7691 | 0 | 0.00562 |
| 253 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | Opt | 0.12 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | 0 | 0 |
| 254 | 0 | 7 | 3 | 0 | 143.3 | 0.7539 | Opt | 0.12 | 0 | 6 | 4 | 0 | 154.3 | 0.7795 | 0.01 | 0.0766 |
| 255 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | Opt | 0.12 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | 0 | 0 |
| 256 | 0 | 6 | 4 | 0 | 154.3 | 0.7544 | Opt | 0.121 | 0 | 5 | 5 | 0 | 165.3 | 0.7753 | 0 | 0.07113 |
| 257 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | Opt | 0.12 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | 0.01 | 0 |
| 258 | 0 | 10 | 0 | 0 | 110.1 | 0.714 | Opt | 0.14 | 0 | 10 | 0 | 3 | 116.1 | 0.7017 | 0 | 0.05449 |
| 259 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | Opt | 0.12 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | 0.01 | 0 |
| 260 | 0 | 8 | 2 | 0 | 132.1 | 0.7059 | Opt | 0.12 | 0 | 7 | 3 | 0 | 143.1 | 0.7144 | 0.01 | 0.08323 |
| 261 | 1 | 9 | 0 | 0 | 99.25 | 0.7276 | Opt | 0.131 | 1 | 9 | 0 | 0 | 99.25 | 0.7276 | 0 | 2.2E-05 |
| 262 | 1 | 9 | 0 | 0 | 99.26 | 0.7231 | Opt | 0.12 | 1 | 9 | 0 | 0 | 99.26 | 0.7111 | 0 | 3.4E-05 |
| 263 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | Opt | 0.13 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | 0 | 0 |
| 264 | 0 | 10 | 0 | 0 | 110.2 | 0.7358 | Opt | 0.14 | 0 | 10 | 0 | 0 | 110.2 | 0.7242 | 0 | 1.8E-05 |
| 265 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | Opt | 0.12 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | 0 | 0 |
| 266 | 0 | 7 | 3 | 0 | 143.2 | 0.7088 | Opt | 0.13 | 0 | 7 | 3 | 1 | 145.2 | 0.7005 | 0.01 | 0.01397 |
| 267 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | Opt | 0.131 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | 0 | 0 |
| 268 | 0 | 6 | 4 | 0 | 154.2 | 0.7105 | Opt | 0.13 | 0 | 6 | 4 | 0 | 154.2 | 0.7016 | 0 | 6.5E-06 |
| 269 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | Opt | 0.12 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | 0.01 | 0 |
| 270 | 0 | 8 | 2 | 0 | 132.3 | 0.7182 | Opt | 0.14 | 0 | 8 | 2 | 0 | 132.3 | 0.7105 | 0 | 1.5E-05 |
| 271 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | Opt | 0.16 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | 0 | 0 |
| 272 | 0 | 7 | 3 | 0 | 143.3 | 0.7218 | Opt | 0.17 | 0 | 7 | 3 | 0 | 143.3 | 0.7144 | 0.011 | 1.4E-05 |
| 273 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.12 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0.01 | 0 |
| 274 | 0 | 9 | 1 | 1 | 123.1 | 0.7514 | Opt | 0.15 | 0 | 8 | 2 | 0 | 132.1 | 0.7577 | 0 | 0.07307 |
| 275 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.13 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0 | 0 |
| 276 | 0 | 6 | 4 | 0 | 154.1 | 0.7539 | Opt | 0.121 | 0 | 5 | 5 | 0 | 165.1 | 0.7593 | 0 | 0.07136 |
| 277 | 0 | 10 | 0 | 0 | 110.1 | 0.7911 | Opt | 0.13 | 0 | 10 | 0 | 0 | 110.1 | 0.7911 | 0.01 | 0 |
| 278 | 0 | 10 | 0 | 0 | 110.2 | 0.7871 | Opt | 0.13 | 0 | 10 | 0 | 0 | 110.2 | 0.774 | 0 | 9.1E-06 |
| 279 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | Opt | 0.13 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | 0 | 0 |
| 280 | 0 | 9 | 1 | 0 | 121.2 | 0.7608 | Opt | 0.14 | 0 | 9 | 1 | 2 | 125.2 | 0.7507 | 0 | 0.03302 |
| 281 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | Opt | 0.12 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | 0.01 | 0 |
| 282 | 0 | 6 | 4 | 1 | 156.2 | 0.7503 | Opt | 0.141 | 0 | 5 | 5 | 0 | 165.2 | 0.7757 | 0 | 0.05754 |
| 283 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | Opt | 1.121 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | 0.01 | 0 |
| 284 | 0 | 5 | 5 | 5 | 175.2 | 0.7501 | Opt | 0.932 | 0 | 4 | 6 | 0 | 176.2 | 0.7691 | 0 | 0.00564 |
| 285 | 0 | 7 | 3 | 0 | 143.2 | 0.755 | Opt | 0.13 | 0 | 7 | 3 | 0 | 143.2 | 0.755 | 0 | 0 |
| 286 | 0 | 7 | 3 | 0 | 143.2 | 0.7539 | Opt | 0.13 | 0 | 6 | 4 | 0 | 154.2 | 0.7795 | 0 | 0.07667 |
| 287 | 0 | 6 | 4 | 0 | 154.2 | 0.7558 | Opt | 0.12 | 0 | 6 | 4 | 0 | 154.2 | 0.7558 | 0.01 | 0 |
| 288 | 0 | 6 | 4 | 0 | 154.2 | 0.7544 | Opt | 0.12 | 0 | 5 | 5 | 0 | 165.2 | 0.7753 | 0.01 | 0.0712 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 289 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 290 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 291 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 292 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 293 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 294 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 295 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 296 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 297 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 298 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 299 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 300 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 301 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 302 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 303 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 304 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 305 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 306 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 307 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 308 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 309 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 310 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 311 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 312 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 313 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 314 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 315 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 316 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 317 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 318 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 319 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 320 | 10 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 321 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 322 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 323 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 324 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 325 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 326 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 327 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 328 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 329 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 330 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 331 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 332 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 333 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 334 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 335 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 336 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 289 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | Opt | 0.121 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | 0.01 | 0 |
| 290 | 0 | 10 | 0 | 0 | 110.1 | 0.714 | Opt | 0.13 | 0 | 10 | 0 | 3 | 116.1 | 0.7017 | 0.01 | 0.05449 |
| 291 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | Opt | 0.12 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | 0.01 | 0 |
| 292 | 0 | 8 | 2 | 0 | 132.1 | 0.7059 | Opt | 0.13 | 0 | 7 | 3 | 0 | 143.1 | 0.7144 | 0.01 | 0.08319 |
| 293 | 1 | 9 | 0 | 0 | 99.41 | 0.7276 | Opt | 0.13 | 1 | 9 | 0 | 0 | 99.41 | 0.7276 | 0 | 4.4E-05 |
| 294 | 1 | 9 | 0 | 0 | 99.43 | 0.7231 | Opt | 0.121 | 1 | 9 | 0 | 0 | 99.42 | 0.7111 | 0 | 6.7E-05 |
| 295 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | Opt | 0.13 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | 0.01 | 0 |
| 296 | 0 | 10 | 0 | 0 | 110.2 | 0.7358 | Opt | 0.13 | 0 | 10 | 0 | 0 | 110.2 | 0.7242 | 0 | 2.7E-05 |
| 297 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | Opt | 0.13 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | 0 | 0 |
| 298 | 0 | 7 | 3 | 0 | 143.2 | 0.7088 | Opt | 0.13 | 0 | 7 | 3 | 1 | 145.2 | 0.7005 | 0.01 | 0.01398 |
| 299 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | Opt | 0.12 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | 0.01 | 0 |
| 300 | 0 | 6 | 4 | 0 | 154.2 | 0.7105 | Opt | 0.181 | 0 | 6 | 4 | 0 | 154.2 | 0.7016 | 0 | 1.9E-05 |
| 301 | 0 | 8 | 2 | 0 | 132.4 | 0.7188 | Opt | 0.13 | 0 | 8 | 2 | 0 | 132.4 | 0.7188 | 0 | 0 |
| 302 | 0 | 8 | 2 | 0 | 132.4 | 0.7182 | Opt | 0.13 | 0 | 8 | 2 | 0 | 132.4 | 0.7105 | 0.01 | 3E-05 |
| 303 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | Opt | 0.16 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | 0.01 | 0 |
| 304 | 0 | 7 | 3 | 0 | 143.4 | 0.7218 | Opt | 0.171 | 0 | 7 | 3 | 0 | 143.4 | 0.7144 | 0 | 2.1E-05 |
| 305 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.13 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0.01 | 0 |
| 306 | 0 | 9 | 1 | 1 | 123.1 | 0.7514 | Opt | 0.15 | 0 | 8 | 2 | 0 | 132.1 | 0.7577 | 0 | 0.07304 |
| 307 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.13 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0 | 0 |
| 308 | 0 | 6 | 4 | 0 | 154.1 | 0.7539 | Opt | 0.13 | 0 | 5 | 5 | 0 | 165.1 | 0.7593 | 0 | 0.07135 |
| 309 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | Opt | 0.131 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | 0.01 | 0 |
| 310 | 0 | 10 | 0 | 0 | 110.2 | 0.7871 | Opt | 0.14 | 0 | 10 | 0 | 0 | 110.2 | 0.774 | 0.01 | 2.7E-05 |
| 311 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | Opt | 0.13 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | 0.01 | 0 |
| 312 | 0 | 9 | 1 | 0 | 121.2 | 0.7608 | Opt | 0.14 | 0 | 9 | 1 | 2 | 125.2 | 0.7507 | 0 | 0.03302 |
| 313 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | Opt | 0.13 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | 0 | 0 |
| 314 | 0 | 6 | 4 | 1 | 156.2 | 0.7503 | Opt | 0.141 | 0 | 5 | 5 | 0 | 165.2 | 0.7757 | 0.01 | 0.05748 |
| 315 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | Opt | 0.57 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | 0 | 0 |
| 316 | 0 | 5 | 5 | 5 | 175.2 | 0.75 | Opt | 1.893 | 0 | 4 | 6 | 0 | 176.2 | 0.7691 | 0.01 | 0.0056 |
| 317 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | Opt | 0.13 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | 0.01 | 0 |
| 318 | 0 | 7 | 3 | 0 | 143.3 | 0.7539 | Opt | 0.131 | 0 | 6 | 4 | 0 | 154.3 | 0.7795 | 0 | 0.07654 |
| 319 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | Opt | 0.14 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | 0 | 0 |
| 320 | 0 | 6 | 4 | 0 | 154.3 | 0.7544 | Opt | 0.13 | 0 | 5 | 5 | 0 | 165.3 | 0.7753 | 0 | 0.07108 |
| 321 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | Opt | 0.13 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | 0 | 0 |
| 322 | 0 | 10 | 0 | 0 | 110.1 | 0.714 | Opt | 0.15 | 0 | 10 | 0 | 3 | 116.1 | 0.7017 | 0.01 | 0.05448 |
| 323 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | Opt | 0.141 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | 0 | 0 |
| 324 | 0 | 8 | 2 | 0 | 132.1 | 0.7059 | Opt | 0.14 | 0 | 7 | 3 | 0 | 143.1 | 0.7144 | 0 | 0.08321 |
| 325 | 1 | 9 | 0 | 0 | 99.3 | 0.7276 | Opt | 0.14 | 1 | 9 | 0 | 0 | 99.3 | 0.7276 | 0 | 2.2E-05 |
| 326 | 1 | 9 | 0 | 0 | 99.31 | 0.7231 | Opt | 0.13 | 1 | 9 | 0 | 0 | 99.31 | 0.7111 | 0 | 3.4E-05 |
| 327 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | Opt | 0.13 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | 0.01 | 0 |
| 328 | 0 | 10 | 0 | 0 | 110.2 | 0.7358 | Opt | 0.141 | 0 | 10 | 0 | 0 | 110.2 | 0.7242 | 0.01 | 1.8E-05 |
| 329 | 0 | 7 | 3 | 0 | 143.3 | 0.7084 | Opt | 0.14 | 0 | 7 | 3 | 0 | 143.3 | 0.7084 | 0 | 0 |
| 330 | 0 | 7 | 3 | 0 | 143.3 | 0.7088 | Opt | 0.15 | 0 | 7 | 3 | 1 | 145.3 | 0.7005 | 0 | 0.01397 |
| 331 | 0 | 6 | 4 | 0 | 154.3 | 0.7106 | Opt | 0.13 | 0 | 6 | 4 | 0 | 154.3 | 0.7106 | 0.01 | 0 |
| 332 | 0 | 6 | 4 | 0 | 154.3 | 0.7105 | Opt | 0.14 | 0 | 6 | 4 | 0 | 154.3 | 0.7016 | 0.01 | 6.5E-06 |
| 333 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | Opt | 0.131 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | 0.01 | 0 |
| 334 | 0 | 8 | 2 | 0 | 132.4 | 0.7182 | Opt | 0.14 | 0 | 8 | 2 | 0 | 132.4 | 0.7105 | 0.01 | 1.5E-05 |
| 335 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | Opt | 0.17 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | 0.01 | 0 |
| 336 | 0 | 7 | 3 | 0 | 143.4 | 0.7218 | Opt | 0.19 | 0 | 7 | 3 | 0 | 143.4 | 0.7144 | 0.01 | 7E-06 |

| Exp # | Input Parameters | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 337 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 338 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 339 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 340 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 341 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 342 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 343 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 344 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 345 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 346 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 347 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 348 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 349 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 350 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 351 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 352 | 10 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 353 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 354 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 355 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 356 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 357 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 358 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 359 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 360 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 361 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 362 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 363 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 364 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 365 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 366 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 367 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 368 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 369 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 370 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 371 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 372 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 373 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 374 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 375 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 376 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 377 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 378 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 379 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 380 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 381 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 382 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 383 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 384 | 10 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 337 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.131 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0.01 | 0 |
| 338 | 0 | 9 | 1 | 1 | 123.1 | 0.7514 | Opt | 0.15 | 0 | 8 | 2 | 0 | 132.1 | 0.7577 | 0 | 0.07307 |
| 339 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.13 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0.01 | 0 |
| 340 | 0 | 6 | 4 | 0 | 154.1 | 0.7539 | Opt | 0.14 | 0 | 5 | 5 | 0 | 165.1 | 0.7593 | 0 | 0.07135 |
| 341 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | Opt | 0.14 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | 0 | 0 |
| 342 | 0 | 10 | 0 | 0 | 110.2 | 0.7871 | Opt | 0.151 | 0 | 10 | 0 | 0 | 110.2 | 0.774 | 0 | 1.8E-05 |
| 343 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | Opt | 0.14 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | 0 | 0 |
| 344 | 0 | 9 | 1 | 0 | 121.2 | 0.7608 | Opt | 0.14 | 0 | 9 | 1 | 2 | 125.2 | 0.7507 | 0 | 0.03301 |
| 345 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | Opt | 0.13 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | 0.01 | 0 |
| 346 | 0 | 6 | 4 | 1 | 156.2 | 0.7503 | Opt | 0.15 | 0 | 5 | 5 | 0 | 165.2 | 0.7757 | 0 | 0.05754 |
| 347 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | Opt | 0.681 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | 0 | 0 |
| 348 | 0 | 5 | 5 | 5 | 175.3 | 0.7501 | Opt | 2.103 | 0 | 4 | 6 | 0 | 176.2 | 0.7691 | 0 | 0.00565 |
| 349 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | Opt | 0.141 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | 0 | 0 |
| 350 | 0 | 7 | 3 | 0 | 143.3 | 0.7539 | Opt | 0.13 | 0 | 6 | 4 | 0 | 154.3 | 0.7795 | 0 | 0.07665 |
| 351 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | Opt | 0.14 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | 0.01 | 0 |
| 352 | 0 | 6 | 4 | 0 | 154.3 | 0.7544 | Opt | 0.14 | 0 | 5 | 5 | 0 | 165.3 | 0.7753 | 0 | 0.07118 |
| 353 | 0 | 10 | 0 | 0 | 110.2 | 0.7148 | Opt | 0.14 | 0 | 10 | 0 | 0 | 110.2 | 0.7148 | 0 | 0 |
| 354 | 0 | 10 | 0 | 0 | 110.2 | 0.714 | Opt | 0.151 | 0 | 10 | 0 | 3 | 116.2 | 0.7017 | 0 | 0.05447 |
| 355 | 0 | 8 | 2 | 0 | 132.2 | 0.7048 | Opt | 0.15 | 0 | 8 | 2 | 0 | 132.2 | 0.7048 | 0 | 0 |
| 356 | 0 | 8 | 2 | 0 | 132.2 | 0.7059 | Opt | 0.14 | 0 | 7 | 3 | 0 | 143.2 | 0.7144 | 0 | 0.08317 |
| 357 | 1 | 9 | 0 | 0 | 99.46 | 0.7276 | Opt | 0.13 | 1 | 9 | 0 | 0 | 99.46 | 0.7276 | 0.01 | 4.4E-05 |
| 358 | 1 | 9 | 0 | 0 | 99.48 | 0.7231 | Opt | 0.131 | 1 | 9 | 0 | 0 | 99.48 | 0.7111 | 0.01 | 6.7E-05 |
| 359 | 0 | 10 | 0 | 0 | 110.3 | 0.7378 | Opt | 0.15 | 0 | 10 | 0 | 0 | 110.3 | 0.7378 | 0 | 0 |
| 360 | 0 | 10 | 0 | 0 | 110.3 | 0.7358 | Opt | 0.15 | 0 | 10 | 0 | 0 | 110.3 | 0.7242 | 0 | 2.7E-05 |
| 361 | 0 | 7 | 3 | 0 | 143.3 | 0.7084 | Opt | 0.13 | 0 | 7 | 3 | 0 | 143.3 | 0.7084 | 0.01 | 0 |
| 362 | 0 | 7 | 3 | 0 | 143.3 | 0.7088 | Opt | 0.14 | 0 | 7 | 3 | 1 | 145.3 | 0.7005 | 0.01 | 0.01397 |
| 363 | 0 | 6 | 4 | 0 | 154.3 | 0.7106 | Opt | 0.131 | 0 | 6 | 4 | 0 | 154.3 | 0.7106 | 0.01 | 0 |
| 364 | 0 | 6 | 4 | 0 | 154.3 | 0.7105 | Opt | 0.15 | 0 | 6 | 4 | 0 | 154.3 | 0.7016 | 0.01 | 1.3E-05 |
| 365 | 0 | 8 | 2 | 0 | 132.4 | 0.7188 | Opt | 0.15 | 0 | 8 | 2 | 0 | 132.4 | 0.7188 | 0 | 0 |
| 366 | 0 | 8 | 2 | 0 | 132.5 | 0.7182 | Opt | 0.15 | 0 | 8 | 2 | 0 | 132.5 | 0.7105 | 0 | 3E-05 |
| 367 | 0 | 7 | 3 | 0 | 143.4 | 0.7222 | Opt | 0.191 | 0 | 7 | 3 | 0 | 143.4 | 0.7222 | 0 | 0 |
| 368 | 0 | 7 | 3 | 0 | 143.4 | 0.7218 | Opt | 0.2 | 0 | 7 | 3 | 0 | 143.5 | 0.7144 | 0 | 2.8E-05 |
| 369 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.14 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0 | 0 |
| 370 | 0 | 9 | 1 | 1 | 123.2 | 0.7514 | Opt | 0.16 | 0 | 8 | 2 | 0 | 132.2 | 0.7577 | 0 | 0.07303 |
| 371 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.14 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0 | 0 |
| 372 | 0 | 6 | 4 | 0 | 154.2 | 0.7539 | Opt | 0.131 | 0 | 5 | 5 | 0 | 165.2 | 0.7593 | 0.01 | 0.07134 |
| 373 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | Opt | 0.15 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | 0 | 0 |
| 374 | 0 | 10 | 0 | 0 | 110.3 | 0.7871 | Opt | 0.14 | 0 | 10 | 0 | 0 | 110.3 | 0.774 | 0.01 | 3.6E-05 |
| 375 | 0 | 9 | 1 | 0 | 121.3 | 0.7631 | Opt | 0.14 | 0 | 9 | 1 | 0 | 121.3 | 0.7631 | 0 | 0 |
| 376 | 0 | 9 | 1 | 0 | 121.3 | 0.7608 | Opt | 0.15 | 0 | 9 | 1 | 2 | 125.3 | 0.7507 | 0 | 0.033 |
| 377 | 0 | 6 | 4 | 0 | 154.3 | 0.7508 | Opt | 0.131 | 0 | 6 | 4 | 0 | 154.3 | 0.7508 | 0.01 | 0 |
| 378 | 0 | 6 | 4 | 1 | 156.3 | 0.7503 | Opt | 0.15 | 0 | 5 | 5 | 0 | 165.3 | 0.7757 | 0.01 | 0.05747 |
| 379 | 0 | 4 | 6 | 0 | 176.3 | 0.7809 | Opt | 0.551 | 0 | 4 | 6 | 0 | 176.3 | 0.7809 | 0.01 | 0 |
| 380 | 0 | 5 | 5 | 5 | 175.3 | 0.75 | Opt | 6.379 | 0 | 4 | 6 | 0 | 176.3 | 0.7691 | 0 | 0.00561 |
| 381 | 0 | 7 | 3 | 0 | 143.4 | 0.755 | Opt | 0.14 | 0 | 7 | 3 | 0 | 143.4 | 0.755 | 0 | 0 |
| 382 | 0 | 7 | 3 | 0 | 143.4 | 0.7539 | Opt | 0.14 | 0 | 6 | 4 | 0 | 154.4 | 0.7795 | 0.01 | 0.07652 |
| 383 | 0 | 6 | 4 | 0 | 154.4 | 0.7558 | Opt | 0.141 | 0 | 6 | 4 | 0 | 154.4 | 0.7558 | 0 | 0 |
| 384 | 0 | 6 | 4 | 0 | 154.4 | 0.7544 | Opt | 0.14 | 0 | 5 | 5 | 0 | 165.4 | 0.7753 | 0.01 | 0.07106 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 385 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 386 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 387 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 388 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 389 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 390 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 391 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 392 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 393 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 394 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 395 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 396 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 397 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 398 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 399 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 400 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 401 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 402 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 403 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 404 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 405 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 406 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 407 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 408 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 409 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 410 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 411 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 412 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 413 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 414 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 415 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 416 | 10 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 417 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 418 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 419 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 420 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 421 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 422 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 423 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 424 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 425 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 426 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 427 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 428 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 429 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 430 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 431 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 432 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 385 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | Opt | 0.14 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | 0 | 0 |
| 386 | 0 | 10 | 0 | 0 | 105.1 | 0.714 | Opt | 0.15 | 0 | 10 | 0 | 3 | 112.6 | 0.7017 | 0.01 | 0.07138 |
| 387 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | Opt | 0.14 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | 0 | 0 |
| 388 | 0 | 8 | 2 | 0 | 126.1 | 0.7059 | Opt | 0.141 | 0 | 7 | 3 | 0 | 136.6 | 0.7144 | 0 | 0.08325 |
| 389 | 1 | 9 | 0 | 0 | 94.73 | 0.7276 | Opt | 0.14 | 1 | 9 | 0 | 0 | 94.73 | 0.7276 | 0.01 | 2.3E-05 |
| 390 | 1 | 9 | 0 | 0 | 94.74 | 0.7231 | Opt | 0.14 | 1 | 9 | 0 | 0 | 94.74 | 0.7111 | 0 | 3.6E-05 |
| 391 | 0 | 10 | 0 | 0 | 105.1 | 0.7378 | Opt | 0.14 | 0 | 10 | 0 | 0 | 105.1 | 0.7378 | 0.01 | 0 |
| 392 | 0 | 10 | 0 | 0 | 105.1 | 0.7358 | Opt | 0.15 | 0 | 10 | 0 | 0 | 105.1 | 0.7242 | 0 | 1.9E-05 |
| 393 | 0 | 7 | 3 | 0 | 136.6 | 0.7084 | Opt | 0.141 | 0 | 7 | 3 | 0 | 136.6 | 0.7084 | 0 | 0 |
| 394 | 0 | 7 | 3 | 0 | 136.7 | 0.7088 | Opt | 0.13 | 0 | 7 | 3 | 1 | 139.2 | 0.7005 | 0.01 | 0.01829 |
| 395 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | 0.01 | 0 |
| 396 | 0 | 6 | 4 | 0 | 147.2 | 0.7105 | Opt | 0.17 | 0 | 6 | 4 | 0 | 147.2 | 0.7016 | 0 | 6.8E-06 |
| 397 | 0 | 8 | 2 | 0 | 126.2 | 0.7188 | Opt | 0.14 | 0 | 8 | 2 | 0 | 126.2 | 0.7188 | 0 | 0 |
| 398 | 0 | 8 | 2 | 0 | 126.2 | 0.7182 | Opt | 0.151 | 0 | 8 | 2 | 0 | 126.2 | 0.7105 | 0 | 1.6E-05 |
| 399 | 0 | 7 | 3 | 0 | 136.7 | 0.7222 | Opt | 0.18 | 0 | 7 | 3 | 0 | 136.7 | 0.7222 | 0.01 | 0 |
| 400 | 0 | 7 | 3 | 0 | 136.7 | 0.7218 | Opt | 0.17 | 0 | 7 | 3 | 0 | 136.7 | 0.7144 | 0 | 1.5E-05 |
| 401 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.13 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0.01 | 0 |
| 402 | 0 | 9 | 1 | 1 | 118.1 | 0.7514 | Opt | 0.171 | 0 | 8 | 2 | 0 | 126.1 | 0.7577 | 0.01 | 0.06773 |
| 403 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.14 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0.01 | 0 |
| 404 | 0 | 6 | 4 | 0 | 147.1 | 0.7539 | Opt | 0.14 | 0 | 5 | 5 | 0 | 157.6 | 0.7593 | 0.01 | 0.07138 |
| 405 | 0 | 10 | 0 | 0 | 105.1 | 0.7911 | Opt | 0.15 | 0 | 10 | 0 | 0 | 105.1 | 0.7911 | 0 | 0 |
| 406 | 0 | 10 | 0 | 0 | 105.1 | 0.7871 | Opt | 0.151 | 0 | 10 | 0 | 0 | 105.1 | 0.774 | 0 | 1.9E-05 |
| 407 | 0 | 9 | 1 | 0 | 115.6 | 0.7631 | Opt | 0.14 | 0 | 9 | 1 | 0 | 115.6 | 0.7631 | 0.01 | 0 |
| 408 | 0 | 9 | 1 | 0 | 115.6 | 0.7608 | Opt | 0.14 | 0 | 9 | 1 | 2 | 120.6 | 0.7507 | 0.01 | 0.04325 |
| 409 | 0 | 6 | 4 | 0 | 147.1 | 0.7508 | Opt | 0.14 | 0 | 6 | 4 | 0 | 147.1 | 0.7508 | 0.01 | 0 |
| 410 | 0 | 6 | 4 | 1 | 149.6 | 0.7503 | Opt | 0.16 | 0 | 5 | 5 | 0 | 157.6 | 0.7757 | 0 | 0.0534 |
| 411 | 0 | 4 | 6 | 0 | 168.1 | 0.7809 | Opt | 0.511 | 0 | 4 | 6 | 0 | 168.1 | 0.7809 | 0 | 0 |
| 412 | 0 | 4 | 6 | 0 | 168.1 | 0.7789 | Opt | 0.541 | 0 | 4 | 6 | 0 | 168.1 | 0.7691 | 0.01 | 0 |
| 413 | 0 | 7 | 3 | 0 | 136.7 | 0.755 | Opt | 0.14 | 0 | 7 | 3 | 0 | 136.7 | 0.755 | 0 | 0 |
| 414 | 0 | 7 | 3 | 0 | 136.7 | 0.7539 | Opt | 0.14 | 0 | 6 | 4 | 0 | 147.2 | 0.7795 | 0.01 | 0.07671 |
| 415 | 0 | 6 | 4 | 0 | 147.2 | 0.7558 | Opt | 0.141 | 0 | 6 | 4 | 0 | 147.2 | 0.7558 | 0.01 | 0 |
| 416 | 0 | 6 | 4 | 0 | 147.2 | 0.7544 | Opt | 0.15 | 0 | 5 | 5 | 0 | 157.7 | 0.7753 | 0 | 0.07124 |
| 417 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | Opt | 0.15 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | 0 | 0 |
| 418 | 0 | 10 | 0 | 0 | 105.1 | 0.714 | Opt | 0.15 | 0 | 10 | 0 | 3 | 112.6 | 0.7017 | 0 | 0.07136 |
| 419 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | Opt | 0.14 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | 0.01 | 0 |
| 420 | 0 | 8 | 2 | 0 | 126.1 | 0.7059 | Opt | 0.161 | 0 | 7 | 3 | 0 | 136.6 | 0.7144 | 0 | 0.08321 |
| 421 | 1 | 9 | 0 | 0 | 94.89 | 0.7276 | Opt | 0.15 | 1 | 9 | 0 | 0 | 94.89 | 0.7276 | 0 | 4.6E-05 |
| 422 | 1 | 9 | 0 | 0 | 94.91 | 0.7231 | Opt | 0.14 | 1 | 9 | 0 | 0 | 94.91 | 0.7111 | 0 | 7.1E-05 |
| 423 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | Opt | 0.15 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | 0.01 | 0 |
| 424 | 0 | 10 | 0 | 0 | 105.2 | 0.7358 | Opt | 0.141 | 0 | 10 | 0 | 0 | 105.2 | 0.7242 | 0.01 | 2.9E-05 |
| 425 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | Opt | 0.14 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | 0.01 | 0 |
| 426 | 0 | 7 | 3 | 0 | 136.7 | 0.7088 | Opt | 0.14 | 0 | 7 | 3 | 1 | 139.2 | 0.7005 | 0.01 | 0.0183 |
| 427 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | 0.01 | 0 |
| 428 | 0 | 6 | 4 | 0 | 147.2 | 0.7105 | Opt | 0.16 | 0 | 6 | 4 | 0 | 147.2 | 0.7016 | 0 | 1.4E-05 |
| 429 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | Opt | 0.161 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | 0 | 0 |
| 430 | 0 | 8 | 2 | 0 | 126.3 | 0.7182 | Opt | 0.15 | 0 | 8 | 2 | 0 | 126.3 | 0.7105 | 0 | 3.2E-05 |
| 431 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | Opt | 0.18 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | 0.01 | 0 |
| 432 | 0 | 7 | 3 | 0 | 136.8 | 0.7218 | Opt | 0.15 | 0 | 7 | 3 | 0 | 136.8 | 0.7144 | 0.01 | 2.9E-05 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 433 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 434 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 435 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 436 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 437 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 438 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 439 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 440 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 441 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 442 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 443 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 444 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 445 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 446 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 447 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 448 | 10 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 449 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 450 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 451 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 452 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 453 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 454 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 455 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 456 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 457 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 458 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 459 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 460 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 461 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 462 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 463 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 464 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 465 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 466 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 467 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 468 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 469 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 470 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 471 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 472 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 473 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 474 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 475 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 476 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 477 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 478 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 479 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 480 | 10 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 433 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.141 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0.01 | 0 |
| 434 | 0 | 9 | 1 | 1 | 118.1 | 0.7514 | Opt | 0.17 | 0 | 8 | 2 | 0 | 126.1 | 0.7577 | 0.01 | 0.0677 |
| 435 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0 | 0 |
| 436 | 0 | 6 | 4 | 0 | 147.1 | 0.7539 | Opt | 0.15 | 0 | 5 | 5 | 0 | 157.6 | 0.7593 | 0 | 0.07137 |
| 437 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | Opt | 0.151 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | 0 | 0 |
| 438 | 0 | 10 | 0 | 0 | 105.2 | 0.7871 | Opt | 0.15 | 0 | 10 | 0 | 0 | 105.2 | 0.774 | 0.01 | 3.8E-05 |
| 439 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | Opt | 0.14 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | 0.01 | 0 |
| 440 | 0 | 9 | 1 | 0 | 115.7 | 0.7608 | Opt | 0.15 | 0 | 9 | 1 | 2 | 120.7 | 0.7507 | 0.01 | 0.04325 |
| 441 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | 0 | 0 |
| 442 | 0 | 6 | 4 | 1 | 149.7 | 0.7503 | Opt | 0.161 | 0 | 5 | 5 | 0 | 157.7 | 0.7757 | 0.01 | 0.05334 |
| 443 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | Opt | 0.28 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | 0 | 0 |
| 444 | 0 | 4 | 6 | 0 | 168.2 | 0.7789 | Opt | 2.333 | 0 | 4 | 6 | 0 | 168.2 | 0.7691 | 0 | 1.2E-05 |
| 445 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | Opt | 0.151 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | 0 | 0 |
| 446 | 0 | 7 | 3 | 0 | 136.8 | 0.7539 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.3 | 0.7795 | 0 | 0.07658 |
| 447 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | 0 | 0 |
| 448 | 0 | 6 | 4 | 0 | 147.3 | 0.7544 | Opt | 0.15 | 0 | 5 | 5 | 0 | 157.8 | 0.7753 | 0 | 0.07111 |
| 449 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | Opt | 0.15 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | 0 | 0 |
| 450 | 0 | 10 | 0 | 0 | 105.1 | 0.714 | Opt | 0.16 | 0 | 10 | 0 | 3 | 112.6 | 0.7017 | 0.011 | 0.07136 |
| 451 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | Opt | 0.15 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | 0 | 0 |
| 452 | 0 | 8 | 2 | 0 | 126.1 | 0.7059 | Opt | 0.15 | 0 | 7 | 3 | 0 | 136.6 | 0.7144 | 0 | 0.08322 |
| 453 | 1 | 9 | 0 | 0 | 94.75 | 0.7276 | Opt | 0.15 | 1 | 9 | 0 | 0 | 94.75 | 0.7276 | 0.01 | 2.3E-05 |
| 454 | 1 | 9 | 0 | 0 | 94.76 | 0.7231 | Opt | 0.151 | 1 | 9 | 0 | 0 | 94.76 | 0.7111 | 0 | 3.6E-05 |
| 455 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | Opt | 0.17 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | 0 | 0 |
| 456 | 0 | 10 | 0 | 0 | 105.2 | 0.7358 | Opt | 0.16 | 0 | 10 | 0 | 0 | 105.2 | 0.7242 | 0 | 1.9E-05 |
| 457 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | Opt | 0.15 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | 0.01 | 0 |
| 458 | 0 | 7 | 3 | 0 | 136.7 | 0.7088 | Opt | 0.151 | 0 | 7 | 3 | 1 | 139.2 | 0.7005 | 0 | 0.0183 |
| 459 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | 0.01 | 0 |
| 460 | 0 | 6 | 4 | 0 | 147.2 | 0.7105 | Opt | 0.16 | 0 | 6 | 4 | 0 | 147.2 | 0.7016 | 0 | 6.8E-06 |
| 461 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | Opt | 0.16 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | 0 | 0 |
| 462 | 0 | 8 | 2 | 0 | 126.3 | 0.7182 | Opt | 0.15 | 0 | 8 | 2 | 0 | 126.3 | 0.7105 | 0 | 1.6E-05 |
| 463 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | Opt | 0.191 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | 0.01 | 0 |
| 464 | 0 | 7 | 3 | 0 | 136.8 | 0.7218 | Opt | 0.17 | 0 | 7 | 3 | 0 | 136.8 | 0.7144 | 0 | 1.5E-05 |
| 465 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.15 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0.01 | 0 |
| 466 | 0 | 9 | 1 | 1 | 118.1 | 0.7514 | Opt | 0.16 | 0 | 8 | 2 | 0 | 126.1 | 0.7577 | 0 | 0.0677 |
| 467 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.151 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0.01 | 0 |
| 468 | 0 | 6 | 4 | 0 | 147.1 | 0.7539 | Opt | 0.15 | 0 | 5 | 5 | 0 | 157.6 | 0.7593 | 0.01 | 0.07136 |
| 469 | 0 | 10 | 0 | 0 | 105.1 | 0.7911 | Opt | 0.16 | 0 | 10 | 0 | 0 | 105.1 | 0.7911 | 0 | 0 |
| 470 | 0 | 10 | 0 | 0 | 105.2 | 0.7871 | Opt | 0.16 | 0 | 10 | 0 | 0 | 105.2 | 0.774 | 0 | 9.5E-06 |
| 471 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | Opt | 0.161 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | 0 | 0 |
| 472 | 0 | 9 | 1 | 0 | 115.7 | 0.7608 | Opt | 0.16 | 0 | 9 | 1 | 2 | 120.7 | 0.7507 | 0 | 0.04324 |
| 473 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | 0 | 0 |
| 474 | 0 | 6 | 4 | 1 | 149.7 | 0.7503 | Opt | 0.16 | 0 | 5 | 5 | 0 | 157.7 | 0.7757 | 0.01 | 0.05335 |
| 475 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | Opt | 0.361 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | 0 | 0 |
| 476 | 0 | 4 | 6 | 0 | 168.2 | 0.7789 | Opt | 0.46 | 0 | 4 | 6 | 0 | 168.2 | 0.7691 | 0 | 5.9E-06 |
| 477 | 0 | 7 | 3 | 0 | 136.7 | 0.755 | Opt | 0.151 | 0 | 7 | 3 | 0 | 136.7 | 0.755 | 0 | 0 |
| 478 | 0 | 7 | 3 | 0 | 136.7 | 0.7539 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.2 | 0.7795 | 0.01 | 0.07665 |
| 479 | 0 | 6 | 4 | 0 | 147.2 | 0.7558 | Opt | 0.16 | 0 | 6 | 4 | 0 | 147.2 | 0.7558 | 0 | 0 |
| 480 | 0 | 6 | 4 | 0 | 147.2 | 0.7544 | Opt | 0.15 | 0 | 5 | 5 | 0 | 157.7 | 0.7753 | 0 | 0.07119 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 481 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 482 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 483 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 484 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 485 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 486 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 487 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 488 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 489 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 490 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 491 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 492 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 493 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 494 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 495 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 496 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 497 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 498 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 499 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 500 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 501 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 502 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 503 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 504 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 505 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 506 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 507 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 508 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 509 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 510 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 511 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 512 | 10 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 513 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 514 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 515 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 516 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 517 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 518 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 519 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 520 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 521 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 522 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 523 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 524 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 525 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 526 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 527 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 528 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 481 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | Opt | 0.151 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | 0.01 | 0 |
| 482 | 0 | 10 | 0 | 0 | 105.1 | 0.714 | Opt | 0.16 | 0 | 10 | 0 | 3 | 112.6 | 0.7017 | 0.01 | 0.07135 |
| 483 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | Opt | 0.16 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | 0 | 0 |
| 484 | 0 | 8 | 2 | 0 | 126.1 | 0.7059 | Opt | 0.16 | 0 | 7 | 3 | 0 | 136.6 | 0.7144 | 0 | 0.08318 |
| 485 | 1 | 9 | 0 | 0 | 94.91 | 0.7276 | Opt | 0.151 | 1 | 9 | 0 | 0 | 94.91 | 0.7276 | 0 | 4.6E-05 |
| 486 | 1 | 9 | 0 | 0 | 94.93 | 0.7231 | Opt | 0.15 | 1 | 9 | 0 | 0 | 94.92 | 0.7111 | 0.01 | 7.1E-05 |
| 487 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | Opt | 0.17 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | 0 | 0 |
| 488 | 0 | 10 | 0 | 0 | 105.2 | 0.7358 | Opt | 0.17 | 0 | 10 | 0 | 0 | 105.2 | 0.7242 | 0 | 2.9E-05 |
| 489 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | Opt | 0.15 | 0 | 7 | 3 | 0 | 136.7 | 0.7084 | 0 | 0 |
| 490 | 0 | 7 | 3 | 0 | 136.7 | 0.7088 | Opt | 0.151 | 0 | 7 | 3 | 1 | 139.2 | 0.7005 | 0.01 | 0.0183 |
| 491 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.2 | 0.7106 | 0.01 | 0 |
| 492 | 0 | 6 | 4 | 0 | 147.2 | 0.7105 | Opt | 0.17 | 0 | 6 | 4 | 0 | 147.2 | 0.7016 | 0.01 | 2E-05 |
| 493 | 0 | 8 | 2 | 0 | 126.4 | 0.7188 | Opt | 0.16 | 0 | 8 | 2 | 0 | 126.4 | 0.7188 | 0 | 0 |
| 494 | 0 | 8 | 2 | 0 | 126.4 | 0.7182 | Opt | 0.171 | 0 | 8 | 2 | 0 | 126.4 | 0.7105 | 0 | 3.2E-05 |
| 495 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | Opt | 0.18 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | 0 | 0 |
| 496 | 0 | 7 | 3 | 0 | 136.9 | 0.7218 | Opt | 0.21 | 0 | 7 | 3 | 0 | 136.9 | 0.7144 | 0 | 2.2E-05 |
| 497 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.16 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0 | 0 |
| 498 | 0 | 9 | 1 | 1 | 118.1 | 0.7514 | Opt | 0.171 | 0 | 8 | 2 | 0 | 126.1 | 0.7577 | 0 | 0.06767 |
| 499 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0.01 | 0 |
| 500 | 0 | 6 | 4 | 0 | 147.1 | 0.7539 | Opt | 0.16 | 0 | 5 | 5 | 0 | 157.6 | 0.7593 | 0 | 0.07135 |
| 501 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | Opt | 0.17 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | 0 | 0 |
| 502 | 0 | 10 | 0 | 0 | 105.2 | 0.7871 | Opt | 0.171 | 0 | 10 | 0 | 0 | 105.2 | 0.774 | 0 | 2.9E-05 |
| 503 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | Opt | 0.16 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | 0 | 0 |
| 504 | 0 | 9 | 1 | 0 | 115.7 | 0.7608 | Opt | 0.17 | 0 | 9 | 1 | 2 | 120.7 | 0.7507 | 0 | 0.04323 |
| 505 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | Opt | 0.16 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | 0 | 0 |
| 506 | 0 | 6 | 4 | 1 | 149.7 | 0.7503 | Opt | 0.171 | 0 | 5 | 5 | 0 | 157.7 | 0.7757 | 0 | 0.05329 |
| 507 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | Opt | 0.31 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | 0 | 0 |
| 508 | 0 | 4 | 6 | 0 | 168.2 | 0.7789 | Opt | 2.253 | 0 | 4 | 6 | 0 | 168.2 | 0.7691 | 0 | 5.9E-06 |
| 509 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | Opt | 0.16 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | 0 | 0 |
| 510 | 0 | 7 | 3 | 0 | 136.8 | 0.7539 | Opt | 0.161 | 0 | 6 | 4 | 0 | 147.3 | 0.7795 | 0 | 0.07653 |
| 511 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | Opt | 0.15 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | 0.01 | 0 |
| 512 | 0 | 6 | 4 | 0 | 147.3 | 0.7544 | Opt | 0.15 | 0 | 5 | 5 | 0 | 157.8 | 0.7753 | 0.01 | 0.07107 |
| 513 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | Opt | 0.16 | 0 | 10 | 0 | 0 | 105.1 | 0.7148 | 0.01 | 0 |
| 514 | 0 | 10 | 0 | 0 | 105.1 | 0.714 | Opt | 0.181 | 0 | 10 | 0 | 3 | 112.6 | 0.7017 | 0 | 0.07133 |
| 515 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | Opt | 0.16 | 0 | 8 | 2 | 0 | 126.1 | 0.7048 | 0 | 0 |
| 516 | 0 | 8 | 2 | 0 | 126.1 | 0.7059 | Opt | 0.16 | 0 | 7 | 3 | 0 | 136.6 | 0.7144 | 0 | 0.0832 |
| 517 | 1 | 9 | 0 | 0 | 94.8 | 0.7276 | Opt | 0.16 | 1 | 9 | 0 | 0 | 94.8 | 0.7276 | 0.01 | 2.3E-05 |
| 518 | 1 | 9 | 0 | 0 | 94.81 | 0.7231 | Opt | 0.161 | 1 | 9 | 0 | 0 | 94.81 | 0.7111 | 0 | 3.6E-05 |
| 519 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | Opt | 0.17 | 0 | 10 | 0 | 0 | 105.2 | 0.7378 | 0 | 0 |
| 520 | 0 | 10 | 0 | 0 | 105.2 | 0.7358 | Opt | 0.16 | 0 | 10 | 0 | 0 | 105.2 | 0.7242 | 0 | 1.9E-05 |
| 521 | 0 | 7 | 3 | 0 | 136.8 | 0.7084 | Opt | 0.16 | 0 | 7 | 3 | 0 | 136.8 | 0.7084 | 0.01 | 0 |
| 522 | 0 | 7 | 3 | 0 | 136.8 | 0.7088 | Opt | 0.161 | 0 | 7 | 3 | 1 | 139.3 | 0.7005 | 0 | 0.01829 |
| 523 | 0 | 6 | 4 | 0 | 147.3 | 0.7106 | Opt | 0.16 | 0 | 6 | 4 | 0 | 147.3 | 0.7106 | 0.01 | 0 |
| 524 | 0 | 6 | 4 | 0 | 147.3 | 0.7105 | Opt | 0.17 | 0 | 6 | 4 | 0 | 147.3 | 0.7016 | 0.01 | 6.8E-06 |
| 525 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | Opt | 0.16 | 0 | 8 | 2 | 0 | 126.3 | 0.7188 | 0 | 0 |
| 526 | 0 | 8 | 2 | 0 | 126.4 | 0.7182 | Opt | 0.171 | 0 | 8 | 2 | 0 | 126.4 | 0.7105 | 0 | 1.6E-05 |
| 527 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | Opt | 0.2 | 0 | 7 | 3 | 0 | 136.8 | 0.7222 | 0.01 | 0 |
| 528 | 0 | 7 | 3 | 0 | 136.9 | 0.7218 | Opt | 0.19 | 0 | 7 | 3 | 0 | 136.9 | 0.7144 | 0 | 7.3E-06 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 529 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 530 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 531 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 532 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 533 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 534 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 535 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 536 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 537 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 538 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 539 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 540 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 541 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 542 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 543 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 544 | 10 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 545 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 546 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 547 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 548 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 549 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 550 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 551 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 552 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 553 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 554 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 555 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 556 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 557 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 558 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 559 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 560 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 561 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 562 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 563 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 564 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 565 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 566 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 567 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 568 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 569 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 570 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 571 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 572 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 573 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 574 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 575 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 576 | 10 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 529 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.16 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0 | 0 |
| 530 | 0 | 9 | 1 | 1 | 118.1 | 0.7514 | Opt | 0.171 | 0 | 8 | 2 | 0 | 126.1 | 0.7577 | 0.01 | 0.06769 |
| 531 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.16 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0.01 | 0 |
| 532 | 0 | 6 | 4 | 0 | 147.1 | 0.7539 | Opt | 0.16 | 0 | 5 | 5 | 0 | 157.6 | 0.7593 | 0 | 0.07135 |
| 533 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | Opt | 0.17 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | 0 | 0 |
| 534 | 0 | 10 | 0 | 0 | 105.2 | 0.7871 | Opt | 0.161 | 0 | 10 | 0 | 0 | 105.2 | 0.774 | 0.01 | 1.9E-05 |
| 535 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | Opt | 0.17 | 0 | 9 | 1 | 0 | 115.7 | 0.7631 | 0 | 0 |
| 536 | 0 | 9 | 1 | 0 | 115.7 | 0.7608 | Opt | 0.16 | 0 | 9 | 1 | 2 | 120.7 | 0.7507 | 0 | 0.04322 |
| 537 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | Opt | 0.16 | 0 | 6 | 4 | 0 | 147.2 | 0.7508 | 0.01 | 0 |
| 538 | 0 | 6 | 4 | 1 | 149.7 | 0.7503 | Opt | 0.181 | 0 | 5 | 5 | 0 | 157.7 | 0.7757 | 0 | 0.05336 |
| 539 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | Opt | 0.731 | 0 | 4 | 6 | 0 | 168.2 | 0.7809 | 0 | 0 |
| 540 | 0 | 4 | 6 | 0 | 168.2 | 0.7789 | Opt | 0.55 | 0 | 4 | 6 | 0 | 168.2 | 0.7691 | 0.01 | 0 |
| 541 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | Opt | 0.171 | 0 | 7 | 3 | 0 | 136.8 | 0.755 | 0 | 0 |
| 542 | 0 | 7 | 3 | 0 | 136.8 | 0.7539 | Opt | 0.16 | 0 | 6 | 4 | 0 | 147.3 | 0.7795 | 0 | 0.07663 |
| 543 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | Opt | 0.16 | 0 | 6 | 4 | 0 | 147.3 | 0.7558 | 0.01 | 0 |
| 544 | 0 | 6 | 4 | 0 | 147.3 | 0.7544 | Opt | 0.17 | 0 | 5 | 5 | 0 | 157.8 | 0.7753 | 0 | 0.07117 |
| 545 | 0 | 10 | 0 | 0 | 105.2 | 0.7148 | Opt | 0.161 | 0 | 10 | 0 | 0 | 105.2 | 0.7148 | 0 | 0 |
| 546 | 0 | 10 | 0 | 0 | 105.2 | 0.714 | Opt | 0.17 | 0 | 10 | 0 | 3 | 112.7 | 0.7017 | 0 | 0.07133 |
| 547 | 0 | 8 | 2 | 0 | 126.2 | 0.7048 | Opt | 0.16 | 0 | 8 | 2 | 0 | 126.2 | 0.7048 | 0.01 | 0 |
| 548 | 0 | 8 | 2 | 0 | 126.2 | 0.7059 | Opt | 0.16 | 0 | 7 | 3 | 0 | 136.7 | 0.7144 | 0.01 | 0.08316 |
| 549 | 1 | 9 | 0 | 0 | 94.96 | 0.7276 | Opt | 0.161 | 1 | 9 | 0 | 0 | 94.96 | 0.7276 | 0 | 4.6E-05 |
| 550 | 1 | 9 | 0 | 0 | 94.98 | 0.7231 | Opt | 0.16 | 1 | 9 | 0 | 0 | 94.98 | 0.7111 | 0.01 | 7.1E-05 |
| 551 | 0 | 10 | 0 | 0 | 105.3 | 0.7378 | Opt | 0.18 | 0 | 10 | 0 | 0 | 105.3 | 0.7378 | 0 | 0 |
| 552 | 0 | 10 | 0 | 0 | 105.3 | 0.7358 | Opt | 0.18 | 0 | 10 | 0 | 0 | 105.3 | 0.7242 | 0 | 2.8E-05 |
| 553 | 0 | 7 | 3 | 0 | 136.8 | 0.7084 | Opt | 0.171 | 0 | 7 | 3 | 0 | 136.8 | 0.7084 | 0 | 0 |
| 554 | 0 | 7 | 3 | 0 | 136.8 | 0.7088 | Opt | 0.17 | 0 | 7 | 3 | 1 | 139.3 | 0.7005 | 0 | 0.01829 |
| 555 | 0 | 6 | 4 | 0 | 147.3 | 0.7106 | Opt | 0.17 | 0 | 6 | 4 | 0 | 147.3 | 0.7106 | 0 | 0 |
| 556 | 0 | 6 | 4 | 0 | 147.3 | 0.7105 | Opt | 0.18 | 0 | 6 | 4 | 0 | 147.3 | 0.7016 | 0 | 1.4E-05 |
| 557 | 0 | 8 | 2 | 0 | 126.4 | 0.7188 | Opt | 0.171 | 0 | 8 | 2 | 0 | 126.4 | 0.7188 | 0.01 | 0 |
| 558 | 0 | 8 | 2 | 0 | 126.5 | 0.7182 | Opt | 0.17 | 0 | 8 | 2 | 0 | 126.5 | 0.7105 | 0 | 3.2E-05 |
| 559 | 0 | 7 | 3 | 0 | 136.9 | 0.7222 | Opt | 0.23 | 0 | 7 | 3 | 0 | 136.9 | 0.7222 | 0 | 0 |
| 560 | 0 | 7 | 3 | 0 | 136.9 | 0.7218 | Opt | 0.21 | 0 | 7 | 3 | 0 | 137 | 0.7144 | 0.01 | 2.9E-05 |
| 561 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | Opt | 0.171 | 0 | 9 | 1 | 0 | 115.6 | 0.7515 | 0 | 0 |
| 562 | 0 | 9 | 1 | 1 | 118.2 | 0.7514 | Opt | 0.19 | 0 | 8 | 2 | 0 | 126.2 | 0.7577 | 0 | 0.06766 |
| 563 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | Opt | 0.17 | 0 | 6 | 4 | 0 | 147.1 | 0.7541 | 0 | 0 |
| 564 | 0 | 6 | 4 | 0 | 147.2 | 0.7539 | Opt | 0.171 | 0 | 5 | 5 | 0 | 157.7 | 0.7593 | 0 | 0.07134 |
| 565 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | Opt | 0.17 | 0 | 10 | 0 | 0 | 105.2 | 0.7911 | 0 | 0 |
| 566 | 0 | 10 | 0 | 0 | 105.3 | 0.7871 | Opt | 0.18 | 0 | 10 | 0 | 0 | 105.3 | 0.774 | 0 | 3.8E-05 |
| 567 | 0 | 9 | 1 | 0 | 115.8 | 0.7631 | Opt | 0.16 | 0 | 9 | 1 | 0 | 115.8 | 0.7631 | 0.01 | 0 |
| 568 | 0 | 9 | 1 | 0 | 115.8 | 0.7608 | Opt | 0.171 | 0 | 9 | 1 | 2 | 120.8 | 0.7507 | 0.01 | 0.0432 |
| 569 | 0 | 6 | 4 | 0 | 147.3 | 0.7508 | Opt | 0.17 | 0 | 6 | 4 | 0 | 147.3 | 0.7508 | 0 | 0 |
| 570 | 0 | 6 | 4 | 1 | 149.8 | 0.7503 | Opt | 0.18 | 0 | 5 | 5 | 0 | 157.8 | 0.7757 | 0 | 0.05329 |
| 571 | 0 | 4 | 6 | 0 | 168.3 | 0.7809 | Opt | 0.3 | 0 | 4 | 6 | 0 | 168.3 | 0.7809 | 0 | 0 |
| 572 | 0 | 4 | 6 | 0 | 168.3 | 0.7789 | Opt | 3.065 | 0 | 4 | 6 | 0 | 168.3 | 0.7691 | 0.01 | 1.2E-05 |
| 573 | 0 | 7 | 3 | 0 | 136.9 | 0.755 | Opt | 0.16 | 0 | 7 | 3 | 0 | 136.9 | 0.755 | 0.01 | 0 |
| 574 | 0 | 7 | 3 | 0 | 136.9 | 0.7539 | Opt | 0.16 | 0 | 6 | 4 | 0 | 147.4 | 0.7795 | 0.01 | 0.0765 |
| 575 | 0 | 6 | 4 | 0 | 147.4 | 0.7558 | Opt | 0.161 | 0 | 6 | 4 | 0 | 147.4 | 0.7558 | 0.01 | 0 |
| 576 | 0 | 6 | 4 | 0 | 147.4 | 0.7544 | Opt | 0.17 | 0 | 5 | 5 | 0 | 157.9 | 0.7753 | 0 | 0.07104 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 577 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 578 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 579 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 580 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 581 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 582 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 583 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 584 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 585 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 586 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 587 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 588 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 589 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 590 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 591 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 592 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 593 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 594 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 595 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 596 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 597 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 598 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 599 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 600 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 601 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 602 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 603 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 604 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 605 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 606 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 607 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 608 | 10 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 609 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 610 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 611 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 612 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 613 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 614 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 615 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 616 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 617 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 618 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 619 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 620 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 621 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 622 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 623 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 624 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 577 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | Opt | 0.18 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | 0 | 0 |
| 578 | 0 | 10 | 0 | 0 | 110.1 | 0.714 | Opt | 0.18 | 0 | 10 | 0 | 3 | 119.1 | 0.7017 | 0 | 0.08177 |
| 579 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | Opt | 0.171 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | 0 | 0 |
| 580 | 0 | 8 | 2 | 0 | 132.1 | 0.7059 | Opt | 0.17 | 0 | 7 | 3 | 0 | 143.1 | 0.7144 | 0 | 0.08326 |
| 581 | 1 | 9 | 0 | 0 | 99.23 | 0.7276 | Opt | 0.17 | 1 | 9 | 0 | 0 | 99.23 | 0.7276 | 0 | 2.2E-05 |
| 582 | 1 | 9 | 0 | 0 | 99.24 | 0.7231 | Opt | 0.16 | 1 | 9 | 0 | 0 | 99.24 | 0.7111 | 0.01 | 3.4E-05 |
| 583 | 0 | 10 | 0 | 0 | 110.1 | 0.7378 | Opt | 0.171 | 0 | 10 | 0 | 0 | 110.1 | 0.7378 | 0 | 0 |
| 584 | 0 | 10 | 0 | 0 | 110.1 | 0.7358 | Opt | 0.17 | 0 | 10 | 0 | 0 | 110.1 | 0.7242 | 0.01 | 1.8E-05 |
| 585 | 0 | 7 | 3 | 0 | 143.1 | 0.7084 | Opt | 0.17 | 0 | 7 | 3 | 0 | 143.1 | 0.7084 | 0 | 0 |
| 586 | 0 | 7 | 3 | 0 | 143.2 | 0.7088 | Opt | 0.17 | 0 | 7 | 3 | 1 | 146.2 | 0.7005 | 0 | 0.02096 |
| 587 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | Opt | 0.181 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | 0 | 0 |
| 588 | 0 | 6 | 4 | 0 | 154.2 | 0.7105 | Opt | 0.19 | 0 | 6 | 4 | 0 | 154.2 | 0.7016 | 0 | 6.5E-06 |
| 589 | 0 | 8 | 2 | 0 | 132.2 | 0.7188 | Opt | 0.17 | 0 | 8 | 2 | 0 | 132.2 | 0.7188 | 0 | 0 |
| 590 | 0 | 8 | 2 | 0 | 132.2 | 0.7182 | Opt | 0.18 | 0 | 8 | 2 | 0 | 132.2 | 0.7105 | 0 | 1.5E-05 |
| 591 | 0 | 7 | 3 | 0 | 143.2 | 0.7222 | Opt | 0.201 | 0 | 7 | 3 | 0 | 143.2 | 0.7222 | 0 | 0 |
| 592 | 0 | 7 | 3 | 0 | 143.2 | 0.7218 | Opt | 0.21 | 0 | 7 | 3 | 0 | 143.2 | 0.7144 | 0.01 | 1.4E-05 |
| 593 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.16 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0.01 | 0 |
| 594 | 0 | 9 | 1 | 1 | 124.1 | 0.7514 | Opt | 0.181 | 0 | 8 | 2 | 0 | 132.1 | 0.7577 | 0.01 | 0.06446 |
| 595 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.17 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0 | 0 |
| 596 | 0 | 6 | 4 | 0 | 154.1 | 0.7539 | Opt | 0.16 | 0 | 5 | 5 | 0 | 165.1 | 0.7593 | 0.01 | 0.07138 |
| 597 | 0 | 10 | 0 | 0 | 110.1 | 0.7911 | Opt | 0.17 | 0 | 10 | 0 | 0 | 110.1 | 0.7911 | 0.01 | 0 |
| 598 | 0 | 10 | 0 | 0 | 110.1 | 0.7871 | Opt | 0.181 | 0 | 10 | 0 | 0 | 110.1 | 0.774 | 0 | 1.8E-05 |
| 599 | 0 | 9 | 1 | 0 | 121.1 | 0.7631 | Opt | 0.17 | 0 | 9 | 1 | 0 | 121.1 | 0.7631 | 0 | 0 |
| 600 | 0 | 9 | 1 | 0 | 121.1 | 0.7608 | Opt | 0.18 | 0 | 9 | 1 | 2 | 127.1 | 0.7507 | 0 | 0.04954 |
| 601 | 0 | 6 | 4 | 0 | 154.1 | 0.7508 | Opt | 0.17 | 0 | 6 | 4 | 0 | 154.1 | 0.7508 | 0 | 0 |
| 602 | 0 | 6 | 4 | 1 | 157.1 | 0.7503 | Opt | 0.191 | 0 | 5 | 5 | 0 | 165.1 | 0.7757 | 0 | 0.05085 |
| 603 | 0 | 4 | 6 | 0 | 176.1 | 0.7809 | Opt | 0.33 | 0 | 4 | 6 | 0 | 176.1 | 0.7809 | 0 | 0 |
| 604 | 0 | 4 | 6 | 0 | 176.1 | 0.7789 | Opt | 1.212 | 0 | 4 | 6 | 0 | 176.1 | 0.7691 | 0 | 0 |
| 605 | 0 | 7 | 3 | 0 | 143.2 | 0.755 | Opt | 0.17 | 0 | 7 | 3 | 0 | 143.2 | 0.755 | 0 | 0 |
| 606 | 0 | 7 | 3 | 0 | 143.2 | 0.7539 | Opt | 0.17 | 0 | 6 | 4 | 0 | 154.2 | 0.7795 | 0 | 0.07672 |
| 607 | 0 | 6 | 4 | 0 | 154.2 | 0.7558 | Opt | 0.17 | 0 | 6 | 4 | 0 | 154.2 | 0.7558 | 0 | 0 |
| 608 | 0 | 6 | 4 | 0 | 154.2 | 0.7544 | Opt | 0.181 | 0 | 5 | 5 | 0 | 165.2 | 0.7753 | 0 | 0.07125 |
| 609 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | Opt | 0.17 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | 0 | 0 |
| 610 | 0 | 10 | 0 | 0 | 110.1 | 0.714 | Opt | 0.17 | 0 | 10 | 0 | 3 | 119.1 | 0.7017 | 0.01 | 0.08175 |
| 611 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | Opt | 0.17 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | 0 | 0 |
| 612 | 0 | 8 | 2 | 0 | 132.1 | 0.7059 | Opt | 0.17 | 0 | 7 | 3 | 0 | 143.1 | 0.7144 | 0.011 | 0.08322 |
| 613 | 1 | 9 | 0 | 0 | 99.39 | 0.7276 | Opt | 0.17 | 1 | 9 | 0 | 0 | 99.39 | 0.7276 | 0 | 4.4E-05 |
| 614 | 1 | 9 | 0 | 0 | 99.41 | 0.7231 | Opt | 0.17 | 1 | 9 | 0 | 0 | 99.41 | 0.7111 | 0.01 | 6.7E-05 |
| 615 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | Opt | 0.181 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | 0 | 0 |
| 616 | 0 | 10 | 0 | 0 | 110.2 | 0.7358 | Opt | 0.18 | 0 | 10 | 0 | 0 | 110.2 | 0.7242 | 0 | 2.7E-05 |
| 617 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | Opt | 0.18 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | 0 | 0 |
| 618 | 0 | 7 | 3 | 0 | 143.2 | 0.7088 | Opt | 0.18 | 0 | 7 | 3 | 1 | 146.2 | 0.7005 | 0 | 0.02096 |
| 619 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | Opt | 0.181 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | 0 | 0 |
| 620 | 0 | 6 | 4 | 0 | 154.2 | 0.7105 | Opt | 0.19 | 0 | 6 | 4 | 0 | 154.2 | 0.7016 | 0 | 1.3E-05 |
| 621 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | Opt | 0.18 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | 0 | 0 |
| 622 | 0 | 8 | 2 | 0 | 132.3 | 0.7182 | Opt | 0.18 | 0 | 8 | 2 | 0 | 132.3 | 0.7105 | 0 | 3E-05 |
| 623 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | Opt | 0.201 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | 0 | 0 |
| 624 | 0 | 7 | 3 | 0 | 143.3 | 0.7218 | Opt | 0.19 | 0 | 7 | 3 | 0 | 143.3 | 0.7144 | 0 | 2.8E-05 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 625 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 626 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 627 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 628 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 629 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 630 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 631 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 632 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 633 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 634 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 635 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 636 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 637 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 638 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 639 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 640 | 10 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 641 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 642 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 643 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 644 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 645 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 646 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 647 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 648 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 649 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 650 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 651 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 652 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 653 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 654 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 655 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 656 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 657 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 658 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 659 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 660 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 661 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 662 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 663 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 664 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 665 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 666 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 667 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 668 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 669 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 670 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 671 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 672 | 10 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 625 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.18 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0 | 0 |
| 626 | 0 | 9 | 1 | 1 | 124.1 | 0.7514 | Opt | 0.19 | 0 | 8 | 2 | 0 | 132.1 | 0.7577 | 0 | 0.06442 |
| 627 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.171 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0 | 0 |
| 628 | 0 | 6 | 4 | 0 | 154.1 | 0.7539 | Opt | 0.17 | 0 | 5 | 5 | 0 | 165.1 | 0.7593 | 0.01 | 0.07137 |
| 629 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | Opt | 0.18 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | 0 | 0 |
| 630 | 0 | 10 | 0 | 0 | 110.2 | 0.7871 | Opt | 0.17 | 0 | 10 | 0 | 0 | 110.2 | 0.774 | 0.01 | 3.6E-05 |
| 631 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | Opt | 0.171 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | 0.01 | 0 |
| 632 | 0 | 9 | 1 | 0 | 121.2 | 0.7608 | Opt | 0.18 | 0 | 9 | 1 | 2 | 127.2 | 0.7507 | 0.01 | 0.04953 |
| 633 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | Opt | 0.17 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | 0 | 0 |
| 634 | 0 | 6 | 4 | 1 | 157.2 | 0.7503 | Opt | 0.181 | 0 | 5 | 5 | 0 | 165.2 | 0.7757 | 0.01 | 0.05079 |
| 635 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | Opt | 0.5 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | 0.01 | 0 |
| 636 | 0 | 4 | 6 | 0 | 176.2 | 0.7789 | Opt | 0.611 | 0 | 4 | 6 | 0 | 176.2 | 0.7691 | 0 | 1.1E-05 |
| 637 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | Opt | 0.18 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | 0 | 0 |
| 638 | 0 | 7 | 3 | 0 | 143.3 | 0.7539 | Opt | 0.181 | 0 | 6 | 4 | 0 | 154.3 | 0.7795 | 0 | 0.0766 |
| 639 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | Opt | 0.17 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | 0 | 0 |
| 640 | 0 | 6 | 4 | 0 | 154.3 | 0.7544 | Opt | 0.17 | 0 | 5 | 5 | 0 | 165.3 | 0.7753 | 0.01 | 0.07113 |
| 641 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | Opt | 0.17 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | 0.01 | 0 |
| 642 | 0 | 10 | 0 | 0 | 110.1 | 0.714 | Opt | 0.191 | 0 | 10 | 0 | 3 | 119.1 | 0.7017 | 0 | 0.08174 |
| 643 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | Opt | 0.17 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | 0 | 0 |
| 644 | 0 | 8 | 2 | 0 | 132.1 | 0.7059 | Opt | 0.18 | 0 | 7 | 3 | 0 | 143.1 | 0.7144 | 0.01 | 0.08323 |
| 645 | 1 | 9 | 0 | 0 | 99.25 | 0.7276 | Opt | 0.17 | 1 | 9 | 0 | 0 | 99.25 | 0.7276 | 0 | 2.2E-05 |
| 646 | 1 | 9 | 0 | 0 | 99.26 | 0.7231 | Opt | 0.171 | 1 | 9 | 0 | 0 | 99.26 | 0.7111 | 0.01 | 3.4E-05 |
| 647 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | Opt | 0.18 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | 0.01 | 0 |
| 648 | 0 | 10 | 0 | 0 | 110.2 | 0.7358 | Opt | 0.18 | 0 | 10 | 0 | 0 | 110.2 | 0.7242 | 0 | 1.8E-05 |
| 649 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | Opt | 0.17 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | 0.01 | 0 |
| 650 | 0 | 7 | 3 | 0 | 143.2 | 0.7088 | Opt | 0.17 | 0 | 7 | 3 | 1 | 146.2 | 0.7005 | 0.011 | 0.02096 |
| 651 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | Opt | 0.17 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | 0.01 | 0 |
| 652 | 0 | 6 | 4 | 0 | 154.2 | 0.7105 | Opt | 0.19 | 0 | 6 | 4 | 0 | 154.2 | 0.7016 | 0.01 | 6.5E-06 |
| 653 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | Opt | 0.181 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | 0 | 0 |
| 654 | 0 | 8 | 2 | 0 | 132.3 | 0.7182 | Opt | 0.18 | 0 | 8 | 2 | 0 | 132.3 | 0.7105 | 0.01 | 1.5E-05 |
| 655 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | Opt | 0.21 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | 0 | 0 |
| 656 | 0 | 7 | 3 | 0 | 143.3 | 0.7218 | Opt | 0.21 | 0 | 7 | 3 | 0 | 143.3 | 0.7144 | 0 | 1.4E-05 |
| 657 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.181 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0 | 0 |
| 658 | 0 | 9 | 1 | 1 | 124.1 | 0.7514 | Opt | 0.19 | 0 | 8 | 2 | 0 | 132.1 | 0.7577 | 0 | 0.06443 |
| 659 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.18 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0.01 | 0 |
| 660 | 0 | 6 | 4 | 0 | 154.1 | 0.7539 | Opt | 0.181 | 0 | 5 | 5 | 0 | 165.1 | 0.7593 | 0 | 0.07136 |
| 661 | 0 | 10 | 0 | 0 | 110.1 | 0.7911 | Opt | 0.18 | 0 | 10 | 0 | 0 | 110.1 | 0.7911 | 0 | 0 |
| 662 | 0 | 10 | 0 | 0 | 110.2 | 0.7871 | Opt | 0.18 | 0 | 10 | 0 | 0 | 110.2 | 0.774 | 0 | 9.1E-06 |
| 663 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | Opt | 0.19 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | 0.01 | 0 |
| 664 | 0 | 9 | 1 | 0 | 121.2 | 0.7608 | Opt | 0.181 | 0 | 9 | 1 | 2 | 127.2 | 0.7507 | 0 | 0.04953 |
| 665 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | Opt | 0.17 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | 0.01 | 0 |
| 666 | 0 | 6 | 4 | 1 | 157.2 | 0.7503 | Opt | 0.19 | 0 | 5 | 5 | 0 | 165.2 | 0.7757 | 0.01 | 0.05081 |
| 667 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | Opt | 0.441 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | 0 | 0 |
| 668 | 0 | 4 | 6 | 0 | 176.2 | 0.7789 | Opt | 1.923 | 0 | 4 | 6 | 0 | 176.2 | 0.7691 | 0.01 | 5.7E-06 |
| 669 | 0 | 7 | 3 | 0 | 143.2 | 0.755 | Opt | 0.18 | 0 | 7 | 3 | 0 | 143.2 | 0.755 | 0 | 0 |
| 670 | 0 | 7 | 3 | 0 | 143.2 | 0.7539 | Opt | 0.18 | 0 | 6 | 4 | 0 | 154.2 | 0.7795 | 0 | 0.07667 |
| 671 | 0 | 6 | 4 | 0 | 154.2 | 0.7558 | Opt | 0.18 | 0 | 6 | 4 | 0 | 154.2 | 0.7558 | 0.01 | 0 |
| 672 | 0 | 6 | 4 | 0 | 154.2 | 0.7544 | Opt | 0.181 | 0 | 5 | 5 | 0 | 165.2 | 0.7753 | 0 | 0.0712 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 673 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 674 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 675 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 676 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 677 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 678 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 679 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 680 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 681 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 682 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 683 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 684 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 685 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 686 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 687 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 688 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 689 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 690 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 691 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 692 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 693 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 694 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 695 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 696 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 697 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 698 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 699 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 700 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 701 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 702 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 703 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 704 | 10 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 705 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 706 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 707 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 708 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 709 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 710 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 711 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 712 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 713 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 714 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 715 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 716 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 717 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 718 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 719 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 720 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 673 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | Opt | 0.18 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | 0 | 0 |
| 674 | 0 | 10 | 0 | 0 | 110.1 | 0.714 | Opt | 0.19 | 0 | 10 | 0 | 3 | 119.1 | 0.7017 | 0 | 0.08173 |
| 675 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | Opt | 0.18 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | 0 | 0 |
| 676 | 0 | 8 | 2 | 0 | 132.1 | 0.7059 | Opt | 0.181 | 0 | 7 | 3 | 0 | 143.1 | 0.7144 | 0.01 | 0.08319 |
| 677 | 1 | 9 | 0 | 0 | 99.41 | 0.7276 | Opt | 0.18 | 1 | 9 | 0 | 0 | 99.41 | 0.7276 | 0 | 4.4E-05 |
| 678 | 1 | 9 | 0 | 0 | 99.43 | 0.7231 | Opt | 0.18 | 1 | 9 | 0 | 0 | 99.42 | 0.7111 | 0.01 | 6.7E-05 |
| 679 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | Opt | 0.2 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | 0 | 0 |
| 680 | 0 | 10 | 0 | 0 | 110.2 | 0.7358 | Opt | 0.191 | 0 | 10 | 0 | 0 | 110.2 | 0.7242 | 0 | 2.7E-05 |
| 681 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | Opt | 0.18 | 0 | 7 | 3 | 0 | 143.2 | 0.7084 | 0.01 | 0 |
| 682 | 0 | 7 | 3 | 0 | 143.2 | 0.7088 | Opt | 0.18 | 0 | 7 | 3 | 1 | 146.2 | 0.7005 | 0 | 0.02096 |
| 683 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | Opt | 0.181 | 0 | 6 | 4 | 0 | 154.2 | 0.7106 | 0.01 | 0 |
| 684 | 0 | 6 | 4 | 0 | 154.2 | 0.7105 | Opt | 0.2 | 0 | 6 | 4 | 0 | 154.2 | 0.7016 | 0 | 1.9E-05 |
| 685 | 0 | 8 | 2 | 0 | 132.4 | 0.7188 | Opt | 0.19 | 0 | 8 | 2 | 0 | 132.4 | 0.7188 | 0 | 0 |
| 686 | 0 | 8 | 2 | 0 | 132.4 | 0.7182 | Opt | 0.19 | 0 | 8 | 2 | 0 | 132.4 | 0.7105 | 0 | 3E-05 |
| 687 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | Opt | 0.221 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | 0 | 0 |
| 688 | 0 | 7 | 3 | 0 | 143.4 | 0.7218 | Opt | 0.22 | 0 | 7 | 3 | 0 | 143.4 | 0.7144 | 0 | 2.1E-05 |
| 689 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.18 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0.01 | 0 |
| 690 | 0 | 9 | 1 | 1 | 124.1 | 0.7514 | Opt | 0.201 | 0 | 8 | 2 | 0 | 132.1 | 0.7577 | 0 | 0.0644 |
| 691 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.18 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0 | 0 |
| 692 | 0 | 6 | 4 | 0 | 154.1 | 0.7539 | Opt | 0.18 | 0 | 5 | 5 | 0 | 165.1 | 0.7593 | 0.01 | 0.07135 |
| 693 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | Opt | 0.19 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | 0 | 0 |
| 694 | 0 | 10 | 0 | 0 | 110.2 | 0.7871 | Opt | 0.191 | 0 | 10 | 0 | 0 | 110.2 | 0.774 | 0.01 | 2.7E-05 |
| 695 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | Opt | 0.19 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | 0 | 0 |
| 696 | 0 | 9 | 1 | 0 | 121.2 | 0.7608 | Opt | 0.19 | 0 | 9 | 1 | 2 | 127.2 | 0.7507 | 0 | 0.04952 |
| 697 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | Opt | 0.18 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | 0 | 0 |
| 698 | 0 | 6 | 4 | 1 | 157.2 | 0.7503 | Opt | 0.19 | 0 | 5 | 5 | 0 | 165.2 | 0.7757 | 0.011 | 0.05075 |
| 699 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | Opt | 0.33 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | 0.01 | 0 |
| 700 | 0 | 4 | 6 | 0 | 176.2 | 0.7789 | Opt | 0.922 | 0 | 4 | 6 | 0 | 176.2 | 0.7691 | 0 | 5.7E-06 |
| 701 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | Opt | 0.18 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | 0.01 | 0 |
| 702 | 0 | 7 | 3 | 0 | 143.3 | 0.7539 | Opt | 0.19 | 0 | 6 | 4 | 0 | 154.3 | 0.7795 | 0 | 0.07654 |
| 703 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | Opt | 0.18 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | 0 | 0 |
| 704 | 0 | 6 | 4 | 0 | 154.3 | 0.7544 | Opt | 0.181 | 0 | 5 | 5 | 0 | 165.3 | 0.7753 | 0.01 | 0.07108 |
| 705 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | Opt | 0.18 | 0 | 10 | 0 | 0 | 110.1 | 0.7148 | 0.01 | 0 |
| 706 | 0 | 10 | 0 | 0 | 110.1 | 0.714 | Opt | 0.2 | 0 | 10 | 0 | 3 | 119.1 | 0.7017 | 0 | 0.08172 |
| 707 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | Opt | 0.191 | 0 | 8 | 2 | 0 | 132.1 | 0.7048 | 0 | 0 |
| 708 | 0 | 8 | 2 | 0 | 132.1 | 0.7059 | Opt | 0.19 | 0 | 7 | 3 | 0 | 143.1 | 0.7144 | 0 | 0.08321 |
| 709 | 1 | 9 | 0 | 0 | 99.3 | 0.7276 | Opt | 0.19 | 1 | 9 | 0 | 0 | 99.3 | 0.7276 | 0 | 2.2E-05 |
| 710 | 1 | 9 | 0 | 0 | 99.31 | 0.7231 | Opt | 0.18 | 1 | 9 | 0 | 0 | 99.31 | 0.7111 | 0 | 3.4E-05 |
| 711 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | Opt | 0.191 | 0 | 10 | 0 | 0 | 110.2 | 0.7378 | 0.01 | 0 |
| 712 | 0 | 10 | 0 | 0 | 110.2 | 0.7358 | Opt | 0.19 | 0 | 10 | 0 | 0 | 110.2 | 0.7242 | 0 | 1.8E-05 |
| 713 | 0 | 7 | 3 | 0 | 143.3 | 0.7084 | Opt | 0.19 | 0 | 7 | 3 | 0 | 143.3 | 0.7084 | 0 | 0 |
| 714 | 0 | 7 | 3 | 0 | 143.3 | 0.7088 | Opt | 0.19 | 0 | 7 | 3 | 1 | 146.3 | 0.7005 | 0 | 0.02095 |
| 715 | 0 | 6 | 4 | 0 | 154.3 | 0.7106 | Opt | 0.201 | 0 | 6 | 4 | 0 | 154.3 | 0.7106 | 0 | 0 |
| 716 | 0 | 6 | 4 | 0 | 154.3 | 0.7105 | Opt | 0.21 | 0 | 6 | 4 | 0 | 154.3 | 0.7016 | 0 | 6.5E-06 |
| 717 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | Opt | 0.19 | 0 | 8 | 2 | 0 | 132.3 | 0.7188 | 0 | 0 |
| 718 | 0 | 8 | 2 | 0 | 132.4 | 0.7182 | Opt | 0.191 | 0 | 8 | 2 | 0 | 132.4 | 0.7105 | 0 | 1.5E-05 |
| 719 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | Opt | 0.21 | 0 | 7 | 3 | 0 | 143.3 | 0.7222 | 0.01 | 0 |
| 720 | 0 | 7 | 3 | 0 | 143.4 | 0.7218 | Opt | 0.23 | 0 | 7 | 3 | 0 | 143.4 | 0.7144 | 0.01 | 7E-06 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 721 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 722 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 723 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 724 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 725 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 726 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 727 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 728 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 729 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 730 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 731 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 732 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 733 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 734 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 735 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 736 | 10 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 737 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 738 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 739 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 740 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 741 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 742 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 743 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 744 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 745 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 746 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 747 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 748 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 749 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 750 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 751 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 752 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 753 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 754 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 755 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 756 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 757 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 758 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 759 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 760 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 761 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 762 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 763 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 764 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 765 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 766 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 767 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 768 | 10 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 721 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.19 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0 | 0 |
| 722 | 0 | 9 | 1 | 1 | 124.1 | 0.7514 | Opt | 0.201 | 0 | 8 | 2 | 0 | 132.1 | 0.7577 | 0 | 0.06442 |
| 723 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.19 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0.01 | 0 |
| 724 | 0 | 6 | 4 | 0 | 154.1 | 0.7539 | Opt | 0.19 | 0 | 5 | 5 | 0 | 165.1 | 0.7593 | 0 | 0.07135 |
| 725 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | Opt | 0.191 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | 0 | 0 |
| 726 | 0 | 10 | 0 | 0 | 110.2 | 0.7871 | Opt | 0.2 | 0 | 10 | 0 | 0 | 110.2 | 0.774 | 0 | 1.8E-05 |
| 727 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | Opt | 0.19 | 0 | 9 | 1 | 0 | 121.2 | 0.7631 | 0.01 | 0 |
| 728 | 0 | 9 | 1 | 0 | 121.2 | 0.7608 | Opt | 0.19 | 0 | 9 | 1 | 2 | 127.2 | 0.7507 | 0 | 0.0495 |
| 729 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | Opt | 0.191 | 0 | 6 | 4 | 0 | 154.2 | 0.7508 | 0 | 0 |
| 730 | 0 | 6 | 4 | 1 | 157.2 | 0.7503 | Opt | 0.21 | 0 | 5 | 5 | 0 | 165.2 | 0.7757 | 0 | 0.05082 |
| 731 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | Opt | 0.341 | 0 | 4 | 6 | 0 | 176.2 | 0.7809 | 0 | 0 |
| 732 | 0 | 4 | 6 | 0 | 176.2 | 0.7789 | Opt | 1.161 | 0 | 4 | 6 | 0 | 176.2 | 0.7691 | 0.01 | 0 |
| 733 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | Opt | 0.19 | 0 | 7 | 3 | 0 | 143.3 | 0.755 | 0 | 0 |
| 734 | 0 | 7 | 3 | 0 | 143.3 | 0.7539 | Opt | 0.191 | 0 | 6 | 4 | 0 | 154.3 | 0.7795 | 0 | 0.07665 |
| 735 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | Opt | 0.19 | 0 | 6 | 4 | 0 | 154.3 | 0.7558 | 0.01 | 0 |
| 736 | 0 | 6 | 4 | 0 | 154.3 | 0.7544 | Opt | 0.19 | 0 | 5 | 5 | 0 | 165.3 | 0.7753 | 0 | 0.07118 |
| 737 | 0 | 10 | 0 | 0 | 110.2 | 0.7148 | Opt | 0.191 | 0 | 10 | 0 | 0 | 110.2 | 0.7148 | 0 | 0 |
| 738 | 0 | 10 | 0 | 0 | 110.2 | 0.714 | Opt | 0.2 | 0 | 10 | 0 | 3 | 119.2 | 0.7017 | 0.01 | 0.08171 |
| 739 | 0 | 8 | 2 | 0 | 132.2 | 0.7048 | Opt | 0.19 | 0 | 8 | 2 | 0 | 132.2 | 0.7048 | 0 | 0 |
| 740 | 0 | 8 | 2 | 0 | 132.2 | 0.7059 | Opt | 0.19 | 0 | 7 | 3 | 0 | 143.2 | 0.7144 | 0.01 | 0.08317 |
| 741 | 1 | 9 | 0 | 0 | 99.46 | 0.7276 | Opt | 0.191 | 1 | 9 | 0 | 0 | 99.46 | 0.7276 | 0 | 4.4E-05 |
| 742 | 1 | 9 | 0 | 0 | 99.48 | 0.7231 | Opt | 0.19 | 1 | 9 | 0 | 0 | 99.48 | 0.7111 | 0 | 6.7E-05 |
| 743 | 0 | 10 | 0 | 0 | 110.3 | 0.7378 | Opt | 0.2 | 0 | 10 | 0 | 0 | 110.3 | 0.7378 | 0.01 | 0 |
| 744 | 0 | 10 | 0 | 0 | 110.3 | 0.7358 | Opt | 0.191 | 0 | 10 | 0 | 0 | 110.3 | 0.7242 | 0.01 | 2.7E-05 |
| 745 | 0 | 7 | 3 | 0 | 143.3 | 0.7084 | Opt | 0.2 | 0 | 7 | 3 | 0 | 143.3 | 0.7084 | 0 | 0 |
| 746 | 0 | 7 | 3 | 0 | 143.3 | 0.7088 | Opt | 0.19 | 0 | 7 | 3 | 1 | 146.3 | 0.7005 | 0 | 0.02095 |
| 747 | 0 | 6 | 4 | 0 | 154.3 | 0.7106 | Opt | 0.19 | 0 | 6 | 4 | 0 | 154.3 | 0.7106 | 0.01 | 0 |
| 748 | 0 | 6 | 4 | 0 | 154.3 | 0.7105 | Opt | 0.211 | 0 | 6 | 4 | 0 | 154.3 | 0.7016 | 0.01 | 1.3E-05 |
| 749 | 0 | 8 | 2 | 0 | 132.4 | 0.7188 | Opt | 0.19 | 0 | 8 | 2 | 0 | 132.4 | 0.7188 | 0 | 0 |
| 750 | 0 | 8 | 2 | 0 | 132.5 | 0.7182 | Opt | 0.2 | 0 | 8 | 2 | 0 | 132.5 | 0.7105 | 0.01 | 3E-05 |
| 751 | 0 | 7 | 3 | 0 | 143.4 | 0.7222 | Opt | 0.221 | 0 | 7 | 3 | 0 | 143.4 | 0.7222 | 0 | 0 |
| 752 | 0 | 7 | 3 | 0 | 143.4 | 0.7218 | Opt | 0.25 | 0 | 7 | 3 | 0 | 143.5 | 0.7144 | 0 | 2.8E-05 |
| 753 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | Opt | 0.19 | 0 | 9 | 1 | 0 | 121.1 | 0.7515 | 0.01 | 0 |
| 754 | 0 | 9 | 1 | 1 | 124.2 | 0.7514 | Opt | 0.211 | 0 | 8 | 2 | 0 | 132.2 | 0.7577 | 0 | 0.06439 |
| 755 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | Opt | 0.19 | 0 | 6 | 4 | 0 | 154.1 | 0.7541 | 0 | 0 |
| 756 | 0 | 6 | 4 | 0 | 154.2 | 0.7539 | Opt | 0.2 | 0 | 5 | 5 | 0 | 165.2 | 0.7593 | 0 | 0.07134 |
| 757 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | Opt | 0.2 | 0 | 10 | 0 | 0 | 110.2 | 0.7911 | 0 | 0 |
| 758 | 0 | 10 | 0 | 0 | 110.3 | 0.7871 | Opt | 0.201 | 0 | 10 | 0 | 0 | 110.3 | 0.774 | 0 | 3.6E-05 |
| 759 | 0 | 9 | 1 | 0 | 121.3 | 0.7631 | Opt | 0.19 | 0 | 9 | 1 | 0 | 121.3 | 0.7631 | 0 | 0 |
| 760 | 0 | 9 | 1 | 0 | 121.3 | 0.7608 | Opt | 0.19 | 0 | 9 | 1 | 2 | 127.3 | 0.7507 | 0.01 | 0.04949 |
| 761 | 0 | 6 | 4 | 0 | 154.3 | 0.7508 | Opt | 0.191 | 0 | 6 | 4 | 0 | 154.3 | 0.7508 | 0.01 | 0 |
| 762 | 0 | 6 | 4 | 1 | 157.3 | 0.7503 | Opt | 0.21 | 0 | 5 | 5 | 0 | 165.3 | 0.7757 | 0 | 0.05075 |
| 763 | 0 | 4 | 6 | 0 | 176.3 | 0.7809 | Opt | 0.511 | 0 | 4 | 6 | 0 | 176.3 | 0.7809 | 0 | 0 |
| 764 | 0 | 4 | 6 | 0 | 176.3 | 0.7789 | Opt | 1.942 | 0 | 4 | 6 | 0 | 176.3 | 0.7691 | 0.01 | 1.1E-05 |
| 765 | 0 | 7 | 3 | 0 | 143.4 | 0.755 | Opt | 0.191 | 0 | 7 | 3 | 0 | 143.4 | 0.755 | 0 | 0 |
| 766 | 0 | 7 | 3 | 0 | 143.4 | 0.7539 | Opt | 0.19 | 0 | 6 | 4 | 0 | 154.4 | 0.7795 | 0 | 0.07652 |
| 767 | 0 | 6 | 4 | 0 | 154.4 | 0.7558 | Opt | 0.19 | 0 | 6 | 4 | 0 | 154.4 | 0.7558 | 0.01 | 0 |
| 768 | 0 | 6 | 4 | 0 | 154.4 | 0.7544 | Opt | 0.191 | 0 | 5 | 5 | 0 | 165.4 | 0.7753 | 0.01 | 0.07106 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 769 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 770 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 771 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 772 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 773 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 774 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 775 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 776 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 777 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 778 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 779 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 780 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 781 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 782 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 783 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 784 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 785 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 786 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 787 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 788 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 789 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 790 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 791 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 792 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 793 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 794 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 795 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 796 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 797 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 798 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 799 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 800 | 20 | 1 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 801 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 802 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 803 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 804 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 805 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 806 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 807 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 808 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 809 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 810 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 811 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 812 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 813 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 814 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 815 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 816 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 769 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | Opt | 0.22 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | 0 | 0 |
| 770 | 1 | 9 | 0 | 12 | 202.6 | 0.7004 | Opt | 0.3 | 0 | 10 | 0 | 3 | 209.6 | 0.7017 | 0 | 0.0343 |
| 771 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | Opt | 0.201 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | 0 | 0 |
| 772 | 0 | 9 | 1 | 13 | 245.1 | 0.7002 | Opt | 0.31 | 0 | 7 | 3 | 0 | 266.6 | 0.7144 | 0 | 0.0877 |
| 773 | 1 | 9 | 0 | 0 | 184.7 | 0.7276 | Opt | 0.2 | 1 | 9 | 0 | 0 | 184.7 | 0.7276 | 0.01 | 1.1E-05 |
| 774 | 1 | 9 | 0 | 0 | 184.7 | 0.7231 | Opt | 0.191 | 1 | 9 | 0 | 0 | 184.7 | 0.7111 | 0 | 1.6E-05 |
| 775 | 0 | 10 | 0 | 0 | 205.1 | 0.7378 | Opt | 0.21 | 0 | 10 | 0 | 0 | 205.1 | 0.7378 | 0 | 0 |
| 776 | 0 | 10 | 0 | 0 | 205.1 | 0.7358 | Opt | 0.2 | 0 | 10 | 0 | 0 | 205.1 | 0.7242 | 0 | 9.7E-06 |
| 777 | 0 | 7 | 3 | 0 | 266.6 | 0.7084 | Opt | 0.201 | 0 | 7 | 3 | 0 | 266.6 | 0.7084 | 0 | 0 |
| 778 | 0 | 7 | 3 | 0 | 266.7 | 0.7088 | Opt | 0.2 | 0 | 7 | 3 | 1 | 268.2 | 0.7005 | 0 | 0.00563 |
| 779 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | Opt | 0.23 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | 0 | 0 |
| 780 | 0 | 6 | 4 | 0 | 287.2 | 0.7105 | Opt | 0.2 | 0 | 6 | 4 | 0 | 287.2 | 0.7016 | 0 | 3.5E-06 |
| 781 | 0 | 8 | 2 | 0 | 246.2 | 0.7188 | Opt | 0.201 | 0 | 8 | 2 | 0 | 246.2 | 0.7188 | 0 | 0 |
| 782 | 0 | 8 | 2 | 0 | 246.2 | 0.7159 | Opt | 0.32 | 0 | 8 | 2 | 0 | 246.2 | 0.7105 | 0.01 | 1.2E-05 |
| 783 | 0 | 7 | 3 | 0 | 266.7 | 0.7222 | Opt | 0.241 | 0 | 7 | 3 | 0 | 266.7 | 0.7222 | 0 | 0 |
| 784 | 0 | 7 | 3 | 0 | 266.7 | 0.7218 | Opt | 0.22 | 0 | 7 | 3 | 0 | 266.7 | 0.7144 | 0 | 7.5E-06 |
| 785 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.2 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0 | 0 |
| 786 | 0 | 9 | 1 | 1 | 227.1 | 0.7514 | Opt | 0.221 | 0 | 8 | 2 | 0 | 246.1 | 0.7577 | 0 | 0.08366 |
| 787 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.2 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0 | 0 |
| 788 | 0 | 6 | 4 | 0 | 287.1 | 0.7539 | Opt | 0.38 | 0 | 5 | 5 | 0 | 307.6 | 0.7593 | 0 | 0.0714 |
| 789 | 0 | 10 | 0 | 0 | 205.1 | 0.7911 | Opt | 0.211 | 0 | 10 | 0 | 0 | 205.1 | 0.7911 | 0 | 0 |
| 790 | 0 | 10 | 0 | 0 | 205.1 | 0.7871 | Opt | 0.2 | 0 | 10 | 0 | 0 | 205.1 | 0.774 | 0.01 | 9.7E-06 |
| 791 | 0 | 9 | 1 | 0 | 225.6 | 0.7631 | Opt | 0.2 | 0 | 9 | 1 | 0 | 225.6 | 0.7631 | 0 | 0 |
| 792 | 0 | 9 | 1 | 0 | 225.6 | 0.7608 | Opt | 0.391 | 0 | 9 | 1 | 2 | 228.6 | 0.7507 | 0 | 0.0133 |
| 793 | 0 | 6 | 4 | 0 | 287.1 | 0.7508 | Opt | 0.2 | 0 | 6 | 4 | 0 | 287.1 | 0.7508 | 0 | 0 |
| 794 | 0 | 6 | 4 | 1 | 288.6 | 0.7503 | Opt | 0.2 | 0 | 5 | 5 | 0 | 307.6 | 0.7757 | 0.01 | 0.06579 |
| 795 | 0 | 4 | 6 | 0 | 328.1 | 0.7809 | Opt | 6.109 | 0 | 4 | 6 | 0 | 328.1 | 0.7809 | 0.01 | 0 |
| 796 | 0 | 5 | 5 | 5 | 315.1 | 0.7501 | Opt | 0.291 | 0 | 4 | 6 | 0 | 328.1 | 0.7691 | 0 | 0.04123 |
| 797 | 0 | 7 | 3 | 0 | 266.7 | 0.755 | Opt | 0.2 | 0 | 7 | 3 | 0 | 266.7 | 0.755 | 0 | 0 |
| 798 | 0 | 7 | 3 | 0 | 266.7 | 0.7539 | Opt | 0.2 | 0 | 6 | 4 | 0 | 287.2 | 0.7795 | 0.01 | 0.07681 |
| 799 | 0 | 6 | 4 | 0 | 287.2 | 0.7558 | Opt | 0.21 | 0 | 6 | 4 | 0 | 287.2 | 0.7558 | 0 | 0 |
| 800 | 0 | 6 | 4 | 0 | 287.2 | 0.7544 | Opt | 0.201 | 0 | 5 | 5 | 0 | 307.7 | 0.7753 | 0 | 0.07133 |
| 801 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | Opt | 0.22 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | 0.01 | 0 |
| 802 | 1 | 9 | 0 | 12 | 202.7 | 0.7001 | Opt | 0.311 | 0 | 10 | 0 | 3 | 209.6 | 0.7017 | 0 | 0.03401 |
| 803 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | Opt | 0.2 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | 0.01 | 0 |
| 804 | 0 | 9 | 1 | 13 | 245.1 | 0.7006 | Opt | 0.38 | 0 | 7 | 3 | 0 | 266.6 | 0.7144 | 0 | 0.08767 |
| 805 | 1 | 9 | 0 | 0 | 184.9 | 0.7276 | Opt | 0.201 | 1 | 9 | 0 | 0 | 184.9 | 0.7276 | 0.01 | 2.2E-05 |
| 806 | 1 | 9 | 0 | 0 | 184.9 | 0.7231 | Opt | 0.2 | 1 | 9 | 0 | 0 | 184.9 | 0.7111 | 0 | 3.8E-05 |
| 807 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | Opt | 0.22 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | 0.01 | 0 |
| 808 | 0 | 10 | 0 | 0 | 205.2 | 0.7358 | Opt | 0.211 | 0 | 10 | 0 | 0 | 205.2 | 0.7242 | 0 | 1.5E-05 |
| 809 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | Opt | 0.21 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | 0.01 | 0 |
| 810 | 0 | 7 | 3 | 0 | 266.7 | 0.7088 | Opt | 0.2 | 0 | 7 | 3 | 1 | 268.2 | 0.7005 | 0 | 0.00563 |
| 811 | 0 | 6 | 4 | 0 | 287.2 | 0.7058 | Opt | 0.321 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | 0.01 | 3.5E-06 |
| 812 | 0 | 6 | 4 | 0 | 287.2 | 0.7105 | Opt | 0.23 | 0 | 6 | 4 | 0 | 287.2 | 0.7016 | 0 | 7E-06 |
| 813 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | Opt | 0.2 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | 0.01 | 0 |
| 814 | 0 | 8 | 2 | 0 | 246.3 | 0.7159 | Opt | 0.341 | 0 | 8 | 2 | 0 | 246.3 | 0.7105 | 0.01 | 2.8E-05 |
| 815 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | Opt | 0.23 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | 0 | 0 |
| 816 | 0 | 7 | 3 | 0 | 266.8 | 0.7218 | Opt | 0.231 | 0 | 7 | 3 | 0 | 266.8 | 0.7144 | 0 | 1.5E-05 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 817 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 818 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 819 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 820 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 821 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 822 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 823 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 824 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 825 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 826 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 827 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 828 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 829 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 830 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 831 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 832 | 20 | 1 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 833 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 834 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 835 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 836 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 837 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 838 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 839 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 840 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 841 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 842 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 843 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 844 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 845 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 846 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 847 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 848 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 849 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 850 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 851 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 852 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 853 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 854 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 855 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 856 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 857 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 858 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 859 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 860 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 861 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 862 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 863 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 864 | 20 | 1 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 817 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.2 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0 | 0 |
| 818 | 0 | 9 | 1 | 1 | 227.1 | 0.7514 | Opt | 0.21 | 0 | 8 | 2 | 0 | 246.1 | 0.7577 | 0.01 | 0.08364 |
| 819 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.2 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0.01 | 0 |
| 820 | 0 | 6 | 4 | 0 | 287.1 | 0.7539 | Opt | 0.401 | 0 | 5 | 5 | 0 | 307.6 | 0.7593 | 0 | 0.0714 |
| 821 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | Opt | 0.21 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | 0.01 | 0 |
| 822 | 0 | 10 | 0 | 0 | 205.2 | 0.7871 | Opt | 0.211 | 0 | 10 | 0 | 0 | 205.2 | 0.774 | 0 | 1.9E-05 |
| 823 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | Opt | 0.22 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | 0 | 0 |
| 824 | 0 | 9 | 1 | 0 | 225.7 | 0.7608 | Opt | 0.39 | 0 | 9 | 1 | 2 | 228.7 | 0.7507 | 0 | 0.01331 |
| 825 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | Opt | 0.211 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | 0 | 0 |
| 826 | 0 | 6 | 4 | 1 | 288.7 | 0.7503 | Opt | 0.21 | 0 | 5 | 5 | 0 | 307.7 | 0.7757 | 0 | 0.06576 |
| 827 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | Opt | 4.947 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | 0.01 | 0 |
| 828 | 0 | 5 | 5 | 5 | 315.2 | 0.7501 | Opt | 0.421 | 0 | 4 | 6 | 0 | 328.2 | 0.7691 | 0.01 | 0.0412 |
| 829 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | Opt | 0.21 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | 0 | 0 |
| 830 | 0 | 7 | 3 | 0 | 266.8 | 0.7539 | Opt | 0.21 | 0 | 6 | 4 | 0 | 287.3 | 0.7795 | 0 | 0.07675 |
| 831 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | Opt | 0.211 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | 0 | 0 |
| 832 | 0 | 6 | 4 | 0 | 287.3 | 0.7544 | Opt | 0.21 | 0 | 5 | 5 | 0 | 307.8 | 0.7753 | 0 | 0.07127 |
| 833 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | Opt | 0.21 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | 0 | 0 |
| 834 | 1 | 9 | 0 | 12 | 202.6 | 0.7002 | Opt | 0.351 | 0 | 10 | 0 | 3 | 209.6 | 0.7017 | 0 | 0.03431 |
| 835 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | Opt | 0.21 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | 0 | 0 |
| 836 | 0 | 9 | 1 | 13 | 245.1 | 0.7005 | Opt | 0.381 | 0 | 7 | 3 | 0 | 266.6 | 0.7144 | 0 | 0.08769 |
| 837 | 1 | 9 | 0 | 0 | 184.7 | 0.7276 | Opt | 0.21 | 1 | 9 | 0 | 0 | 184.7 | 0.7276 | 0 | 1.1E-05 |
| 838 | 1 | 9 | 0 | 0 | 184.8 | 0.7231 | Opt | 0.2 | 1 | 9 | 0 | 0 | 184.8 | 0.7111 | 0.01 | 1.6E-05 |
| 839 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | Opt | 0.201 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | 0.01 | 0 |
| 840 | 0 | 10 | 0 | 0 | 205.2 | 0.7358 | Opt | 0.21 | 0 | 10 | 0 | 0 | 205.2 | 0.7242 | 0.01 | 9.7E-06 |
| 841 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | Opt | 0.21 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | 0.01 | 0 |
| 842 | 0 | 7 | 3 | 0 | 266.7 | 0.7088 | Opt | 0.211 | 0 | 7 | 3 | 1 | 268.2 | 0.7005 | 0 | 0.00563 |
| 843 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | Opt | 0.23 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | 0 | 0 |
| 844 | 0 | 6 | 4 | 0 | 287.2 | 0.7105 | Opt | 0.21 | 0 | 6 | 4 | 0 | 287.2 | 0.7016 | 0 | 3.5E-06 |
| 845 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | Opt | 0.21 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | 0 | 0 |
| 846 | 0 | 8 | 2 | 0 | 246.3 | 0.7159 | Opt | 0.36 | 0 | 8 | 2 | 0 | 246.3 | 0.7105 | 0.011 | 1.2E-05 |
| 847 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | Opt | 0.24 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | 0 | 0 |
| 848 | 0 | 7 | 3 | 0 | 266.8 | 0.7218 | Opt | 0.251 | 0 | 7 | 3 | 0 | 266.8 | 0.7144 | 0 | 7.5E-06 |
| 849 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.21 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0.01 | 0 |
| 850 | 0 | 9 | 1 | 1 | 227.1 | 0.7514 | Opt | 0.22 | 0 | 8 | 2 | 0 | 246.1 | 0.7577 | 0 | 0.08364 |
| 851 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.201 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0.01 | 0 |
| 852 | 0 | 6 | 4 | 0 | 287.1 | 0.7539 | Opt | 0.37 | 0 | 5 | 5 | 0 | 307.6 | 0.7593 | 0.01 | 0.07139 |
| 853 | 0 | 10 | 0 | 0 | 205.1 | 0.7911 | Opt | 0.221 | 0 | 10 | 0 | 0 | 205.1 | 0.7911 | 0 | 0 |
| 854 | 0 | 10 | 0 | 0 | 205.2 | 0.7871 | Opt | 0.21 | 0 | 10 | 0 | 0 | 205.2 | 0.774 | 0 | 4.9E-06 |
| 855 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | Opt | 0.22 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | 0 | 0 |
| 856 | 0 | 9 | 1 | 0 | 225.7 | 0.7608 | Opt | 0.301 | 0 | 9 | 1 | 2 | 228.7 | 0.7507 | 0 | 0.0133 |
| 857 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | Opt | 0.21 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | 0 | 0 |
| 858 | 0 | 6 | 4 | 1 | 288.7 | 0.7503 | Opt | 0.22 | 0 | 5 | 5 | 0 | 307.7 | 0.7757 | 0 | 0.06577 |
| 859 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | Opt | 6.85 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | 0 | 0 |
| 860 | 0 | 5 | 5 | 5 | 315.2 | 0.7501 | Opt | 0.471 | 0 | 4 | 6 | 0 | 328.2 | 0.7691 | 0 | 0.04121 |
| 861 | 0 | 7 | 3 | 0 | 266.7 | 0.755 | Opt | 0.21 | 0 | 7 | 3 | 0 | 266.7 | 0.755 | 0 | 0 |
| 862 | 0 | 7 | 3 | 0 | 266.7 | 0.7539 | Opt | 0.21 | 0 | 6 | 4 | 0 | 287.2 | 0.7795 | 0.01 | 0.07678 |
| 863 | 0 | 6 | 4 | 0 | 287.2 | 0.7558 | Opt | 0.211 | 0 | 6 | 4 | 0 | 287.2 | 0.7558 | 0 | 0 |
| 864 | 0 | 6 | 4 | 0 | 287.2 | 0.7544 | Opt | 0.21 | 0 | 5 | 5 | 0 | 307.7 | 0.7753 | 0 | 0.07131 |

| | Input Parameters | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 865 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 866 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 867 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 868 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 869 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 870 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 871 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 872 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 873 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 874 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 875 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 876 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 877 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 878 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 879 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 880 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 881 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 882 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 883 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 884 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 885 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 886 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 887 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 888 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 889 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 890 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 891 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 892 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 893 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 894 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 895 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 896 | 20 | 1 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 897 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 898 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 899 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 900 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 901 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 902 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 903 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 904 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 905 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 906 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 907 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 908 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 909 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 910 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 911 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 912 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 865 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | Opt | 0.21 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | 0.01 | 0 |
| 866 | 1 | 9 | 0 | 12 | 202.7 | 0.7001 | Opt | 0.331 | 0 | 10 | 0 | 3 | 209.6 | 0.7017 | 0 | 0.03403 |
| 867 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | Opt | 0.21 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | 0 | 0 |
| 868 | 0 | 9 | 1 | 13 | 245.1 | 0.7006 | Opt | 0.391 | 0 | 7 | 3 | 0 | 266.6 | 0.7144 | 0 | 0.08766 |
| 869 | 1 | 9 | 0 | 0 | 184.9 | 0.7276 | Opt | 0.21 | 1 | 9 | 0 | 0 | 184.9 | 0.7276 | 0 | 2.2E-05 |
| 870 | 1 | 9 | 0 | 0 | 184.9 | 0.7231 | Opt | 0.21 | 1 | 9 | 0 | 0 | 184.9 | 0.7111 | 0.01 | 3.8E-05 |
| 871 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | Opt | 0.211 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | 0 | 0 |
| 872 | 0 | 10 | 0 | 0 | 205.2 | 0.7358 | Opt | 0.22 | 0 | 10 | 0 | 0 | 205.2 | 0.7242 | 0.01 | 1.5E-05 |
| 873 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | Opt | 0.22 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | 0 | 0 |
| 874 | 0 | 7 | 3 | 0 | 266.7 | 0.7088 | Opt | 0.21 | 0 | 7 | 3 | 1 | 268.2 | 0.7005 | 0 | 0.00563 |
| 875 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | Opt | 0.211 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | 0.01 | 0 |
| 876 | 0 | 6 | 4 | 0 | 287.2 | 0.7105 | Opt | 0.23 | 0 | 6 | 4 | 0 | 287.2 | 0.7016 | 0 | 1E-05 |
| 877 | 0 | 8 | 2 | 0 | 246.4 | 0.7188 | Opt | 0.22 | 0 | 8 | 2 | 0 | 246.4 | 0.7188 | 0 | 0 |
| 878 | 0 | 8 | 2 | 0 | 246.4 | 0.7159 | Opt | 0.351 | 0 | 8 | 2 | 0 | 246.4 | 0.7105 | 0 | 2.4E-05 |
| 879 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | Opt | 0.25 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | 0 | 0 |
| 880 | 0 | 7 | 3 | 0 | 266.9 | 0.7218 | Opt | 0.261 | 0 | 7 | 3 | 0 | 266.9 | 0.7144 | 0 | 1.1E-05 |
| 881 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.21 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0 | 0 |
| 882 | 0 | 9 | 1 | 1 | 227.1 | 0.7514 | Opt | 0.22 | 0 | 8 | 2 | 0 | 246.1 | 0.7577 | 0.01 | 0.08363 |
| 883 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.211 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0.01 | 0 |
| 884 | 0 | 6 | 4 | 0 | 287.1 | 0.7539 | Opt | 0.41 | 0 | 5 | 5 | 0 | 307.6 | 0.7593 | 0 | 0.07139 |
| 885 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | Opt | 0.221 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | 0 | 0 |
| 886 | 0 | 10 | 0 | 0 | 205.2 | 0.7871 | Opt | 0.22 | 0 | 10 | 0 | 0 | 205.2 | 0.774 | 0 | 1.5E-05 |
| 887 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | Opt | 0.22 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | 0 | 0 |
| 888 | 0 | 9 | 1 | 0 | 225.7 | 0.7608 | Opt | 0.341 | 0 | 9 | 1 | 2 | 228.7 | 0.7507 | 0 | 0.0133 |
| 889 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | Opt | 0.21 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | 0 | 0 |
| 890 | 0 | 6 | 4 | 1 | 288.7 | 0.7503 | Opt | 0.22 | 0 | 5 | 5 | 0 | 307.7 | 0.7757 | 0.01 | 0.06573 |
| 891 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | Opt | 6.98 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | 0 | 0 |
| 892 | 0 | 5 | 5 | 5 | 315.2 | 0.7501 | Opt | 0.341 | 0 | 4 | 6 | 0 | 328.2 | 0.7691 | 0.01 | 0.04118 |
| 893 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | Opt | 0.21 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | 0.01 | 0 |
| 894 | 0 | 7 | 3 | 0 | 266.8 | 0.7539 | Opt | 0.22 | 0 | 6 | 4 | 0 | 287.3 | 0.7795 | 0 | 0.07672 |
| 895 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | Opt | 0.221 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | 0 | 0 |
| 896 | 0 | 6 | 4 | 0 | 287.3 | 0.7544 | Opt | 0.22 | 0 | 5 | 5 | 0 | 307.8 | 0.7753 | 0 | 0.07124 |
| 897 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | Opt | 0.23 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | 0 | 0 |
| 898 | 1 | 9 | 0 | 12 | 202.7 | 0.7004 | Opt | 0.331 | 0 | 10 | 0 | 3 | 209.6 | 0.7017 | 0.01 | 0.03431 |
| 899 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | Opt | 0.22 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | 0 | 0 |
| 900 | 0 | 9 | 1 | 13 | 245.1 | 0.7002 | Opt | 0.331 | 0 | 7 | 3 | 0 | 266.6 | 0.7144 | 0 | 0.08768 |
| 901 | 1 | 9 | 0 | 0 | 184.8 | 0.7276 | Opt | 0.21 | 1 | 9 | 0 | 0 | 184.8 | 0.7276 | 0.01 | 1.1E-05 |
| 902 | 1 | 9 | 0 | 0 | 184.8 | 0.7231 | Opt | 0.22 | 1 | 9 | 0 | 0 | 184.8 | 0.7111 | 0 | 2.2E-05 |
| 903 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | Opt | 0.231 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | 0.01 | 0 |
| 904 | 0 | 10 | 0 | 0 | 205.2 | 0.7358 | Opt | 0.22 | 0 | 10 | 0 | 0 | 205.2 | 0.7242 | 0 | 9.7E-06 |
| 905 | 0 | 7 | 3 | 0 | 266.8 | 0.7084 | Opt | 0.22 | 0 | 7 | 3 | 0 | 266.8 | 0.7084 | 0.01 | 0 |
| 906 | 0 | 7 | 3 | 0 | 266.8 | 0.7088 | Opt | 0.221 | 0 | 7 | 3 | 1 | 268.3 | 0.7005 | 0 | 0.00563 |
| 907 | 0 | 6 | 4 | 0 | 287.3 | 0.7106 | Opt | 0.24 | 0 | 6 | 4 | 0 | 287.3 | 0.7106 | 0 | 0 |
| 908 | 0 | 6 | 4 | 0 | 287.3 | 0.7105 | Opt | 0.22 | 0 | 6 | 4 | 0 | 287.3 | 0.7016 | 0.01 | 3.5E-06 |
| 909 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | Opt | 0.221 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | 0 | 0 |
| 910 | 0 | 8 | 2 | 0 | 246.4 | 0.7159 | Opt | 0.33 | 0 | 8 | 2 | 0 | 246.4 | 0.7105 | 0.01 | 8.1E-06 |
| 911 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | Opt | 0.271 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | 0 | 0 |
| 912 | 0 | 7 | 3 | 0 | 266.9 | 0.7218 | Opt | 0.24 | 0 | 7 | 3 | 0 | 266.9 | 0.7144 | 0 | 3.7E-06 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 913 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 914 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 915 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 916 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 917 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 918 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 919 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 920 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 921 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 922 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 923 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 924 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 925 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 926 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 927 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 928 | 20 | 1 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 929 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 930 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 931 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 932 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 933 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 934 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 935 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 936 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 937 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 938 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 939 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 940 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 941 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 942 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 943 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 944 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 945 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 946 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 947 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 948 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 949 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 950 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 951 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 952 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 953 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 954 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 955 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 956 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 957 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 958 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 959 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 960 | 20 | 1 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 913 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.22 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0 | 0 |
| 914 | 0 | 9 | 1 | 1 | 227.1 | 0.7514 | Opt | 0.231 | 0 | 8 | 2 | 0 | 246.1 | 0.7577 | 0 | 0.08364 |
| 915 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.21 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0.01 | 0 |
| 916 | 0 | 6 | 4 | 0 | 287.1 | 0.7539 | Opt | 0.34 | 0 | 5 | 5 | 0 | 307.6 | 0.7593 | 0.01 | 0.07139 |
| 917 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | Opt | 0.231 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | 0 | 0 |
| 918 | 0 | 10 | 0 | 0 | 205.2 | 0.7871 | Opt | 0.21 | 0 | 10 | 0 | 0 | 205.2 | 0.774 | 0.01 | 9.7E-06 |
| 919 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | Opt | 0.22 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | 0.01 | 0 |
| 920 | 0 | 9 | 1 | 0 | 225.7 | 0.7608 | Opt | 0.401 | 0 | 9 | 1 | 2 | 228.7 | 0.7507 | 0 | 0.0133 |
| 921 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | Opt | 0.22 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | 0.01 | 0 |
| 922 | 0 | 6 | 4 | 1 | 288.7 | 0.7503 | Opt | 0.231 | 0 | 5 | 5 | 0 | 307.7 | 0.7757 | 0 | 0.06577 |
| 923 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | Opt | 5.227 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | 0 | 0 |
| 924 | 0 | 5 | 5 | 5 | 315.3 | 0.7501 | Opt | 0.301 | 0 | 4 | 6 | 0 | 328.2 | 0.7691 | 0.01 | 0.04121 |
| 925 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | Opt | 0.22 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | 0 | 0 |
| 926 | 0 | 7 | 3 | 0 | 266.8 | 0.7539 | Opt | 0.22 | 0 | 6 | 4 | 0 | 287.3 | 0.7795 | 0.01 | 0.07677 |
| 927 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | Opt | 0.22 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | 0 | 0 |
| 928 | 0 | 6 | 4 | 0 | 287.3 | 0.7544 | Opt | 0.22 | 0 | 5 | 5 | 0 | 307.8 | 0.7753 | 0.011 | 0.0713 |
| 929 | 0 | 10 | 0 | 0 | 205.2 | 0.7148 | Opt | 0.24 | 0 | 10 | 0 | 0 | 205.2 | 0.7148 | 0 | 0 |
| 930 | 1 | 9 | 0 | 12 | 202.8 | 0.7004 | Opt | 0.331 | 0 | 10 | 0 | 3 | 209.7 | 0.7017 | 0 | 0.03403 |
| 931 | 0 | 8 | 2 | 0 | 246.2 | 0.7048 | Opt | 0.22 | 0 | 8 | 2 | 0 | 246.2 | 0.7048 | 0.01 | 0 |
| 932 | 0 | 9 | 1 | 13 | 245.2 | 0.7006 | Opt | 0.35 | 0 | 7 | 3 | 0 | 266.7 | 0.7144 | 0 | 0.08765 |
| 933 | 1 | 9 | 0 | 0 | 185 | 0.7276 | Opt | 0.211 | 1 | 9 | 0 | 0 | 185 | 0.7276 | 0.01 | 2.2E-05 |
| 934 | 1 | 9 | 0 | 0 | 185 | 0.7231 | Opt | 0.22 | 1 | 9 | 0 | 0 | 185 | 0.7111 | 0.01 | 3.8E-05 |
| 935 | 0 | 10 | 0 | 0 | 205.3 | 0.7378 | Opt | 0.24 | 0 | 10 | 0 | 0 | 205.3 | 0.7378 | 0 | 0 |
| 936 | 0 | 10 | 0 | 0 | 205.3 | 0.7358 | Opt | 0.221 | 0 | 10 | 0 | 0 | 205.3 | 0.7242 | 0 | 1.5E-05 |
| 937 | 0 | 7 | 3 | 0 | 266.8 | 0.7084 | Opt | 0.23 | 0 | 7 | 3 | 0 | 266.8 | 0.7084 | 0.01 | 0 |
| 938 | 0 | 7 | 3 | 0 | 266.8 | 0.7088 | Opt | 0.22 | 0 | 7 | 3 | 1 | 268.3 | 0.7005 | 0 | 0.00563 |
| 939 | 0 | 6 | 4 | 0 | 287.3 | 0.7058 | Opt | 0.351 | 0 | 6 | 4 | 0 | 287.3 | 0.7106 | 0 | 7E-06 |
| 940 | 0 | 6 | 4 | 0 | 287.3 | 0.7105 | Opt | 0.23 | 0 | 6 | 4 | 0 | 287.3 | 0.7016 | 0 | 7E-06 |
| 941 | 0 | 8 | 2 | 0 | 246.4 | 0.7188 | Opt | 0.221 | 0 | 8 | 2 | 0 | 246.4 | 0.7188 | 0.01 | 0 |
| 942 | 0 | 8 | 2 | 0 | 246.4 | 0.7159 | Opt | 0.33 | 0 | 8 | 2 | 0 | 246.5 | 0.7105 | 0.01 | 2.4E-05 |
| 943 | 0 | 7 | 3 | 0 | 266.9 | 0.7222 | Opt | 0.27 | 0 | 7 | 3 | 0 | 266.9 | 0.7222 | 0 | 0 |
| 944 | 0 | 7 | 3 | 0 | 266.9 | 0.7218 | Opt | 0.24 | 0 | 7 | 3 | 0 | 267 | 0.7144 | 0 | 1.5E-05 |
| 945 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.22 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0.01 | 0 |
| 946 | 0 | 9 | 1 | 1 | 227.2 | 0.7514 | Opt | 0.241 | 0 | 8 | 2 | 0 | 246.2 | 0.7577 | 0 | 0.08362 |
| 947 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.22 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0 | 0 |
| 948 | 0 | 6 | 4 | 0 | 287.2 | 0.7539 | Opt | 0.43 | 0 | 5 | 5 | 0 | 307.7 | 0.7593 | 0.01 | 0.07138 |
| 949 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | Opt | 0.231 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | 0.01 | 0 |
| 950 | 0 | 10 | 0 | 0 | 205.3 | 0.7871 | Opt | 0.22 | 0 | 10 | 0 | 0 | 205.3 | 0.774 | 0.01 | 1.9E-05 |
| 951 | 0 | 9 | 1 | 0 | 225.8 | 0.7631 | Opt | 0.23 | 0 | 9 | 1 | 0 | 225.8 | 0.7631 | 0 | 0 |
| 952 | 0 | 9 | 1 | 0 | 225.8 | 0.7608 | Opt | 0.421 | 0 | 9 | 1 | 2 | 228.8 | 0.7507 | 0 | 0.0133 |
| 953 | 0 | 6 | 4 | 0 | 287.3 | 0.7508 | Opt | 0.22 | 0 | 6 | 4 | 0 | 287.3 | 0.7508 | 0.01 | 0 |
| 954 | 0 | 6 | 4 | 1 | 288.8 | 0.7503 | Opt | 0.231 | 0 | 5 | 5 | 0 | 307.8 | 0.7757 | 0 | 0.06573 |
| 955 | 0 | 4 | 6 | 0 | 328.3 | 0.7809 | Opt | 5.508 | 0 | 4 | 6 | 0 | 328.3 | 0.7809 | 0.01 | 0 |
| 956 | 0 | 5 | 5 | 5 | 315.3 | 0.7501 | Opt | 0.31 | 0 | 4 | 6 | 0 | 328.3 | 0.7691 | 0 | 0.04118 |
| 957 | 0 | 7 | 3 | 0 | 266.9 | 0.755 | Opt | 0.23 | 0 | 7 | 3 | 0 | 266.9 | 0.755 | 0 | 0 |
| 958 | 0 | 7 | 3 | 0 | 266.9 | 0.7539 | Opt | 0.231 | 0 | 6 | 4 | 0 | 287.4 | 0.7795 | 0 | 0.07671 |
| 959 | 0 | 6 | 4 | 0 | 287.4 | 0.7558 | Opt | 0.23 | 0 | 6 | 4 | 0 | 287.4 | 0.7558 | 0 | 0 |
| 960 | 0 | 6 | 4 | 0 | 287.4 | 0.7544 | Opt | 0.23 | 0 | 5 | 5 | 0 | 307.9 | 0.7753 | 0 | 0.07123 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 961 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 962 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 963 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 964 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 965 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 966 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 967 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 968 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 969 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 970 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 971 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 972 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 973 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 974 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 975 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 976 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 977 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 978 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 979 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 980 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 981 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 982 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 983 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 984 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 985 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 986 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 987 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 988 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 989 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 990 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 991 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 992 | 20 | 1 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 993 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 994 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 995 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 996 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 997 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 998 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 999 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1000 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1001 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1002 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1003 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1004 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1005 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1006 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1007 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1008 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 961 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | Opt | 0.231 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | 0 | 0 |
| 962 | 0 | 10 | 0 | 0 | 210.1 | 0.714 | Opt | 0.28 | 0 | 10 | 0 | 3 | 216.1 | 0.7017 | 0 | 0.02857 |
| 963 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | Opt | 0.231 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | 0 | 0 |
| 964 | 0 | 8 | 2 | 0 | 252.1 | 0.7059 | Opt | 0.32 | 0 | 7 | 3 | 0 | 273.1 | 0.7144 | 0 | 0.08329 |
| 965 | 1 | 9 | 0 | 0 | 189.2 | 0.7276 | Opt | 0.23 | 1 | 9 | 0 | 0 | 189.2 | 0.7276 | 0 | 1.1E-05 |
| 966 | 1 | 9 | 0 | 0 | 189.2 | 0.7231 | Opt | 0.221 | 1 | 9 | 0 | 0 | 189.2 | 0.7111 | 0.01 | 1.6E-05 |
| 967 | 0 | 10 | 0 | 0 | 210.1 | 0.7378 | Opt | 0.22 | 0 | 10 | 0 | 0 | 210.1 | 0.7378 | 0 | 0 |
| 968 | 0 | 10 | 0 | 0 | 210.1 | 0.7358 | Opt | 0.23 | 0 | 10 | 0 | 0 | 210.1 | 0.7242 | 0.01 | 9.5E-06 |
| 969 | 0 | 7 | 3 | 0 | 273.1 | 0.7084 | Opt | 0.231 | 0 | 7 | 3 | 0 | 273.1 | 0.7084 | 0 | 0 |
| 970 | 0 | 7 | 3 | 0 | 273.2 | 0.7088 | Opt | 0.23 | 0 | 7 | 3 | 1 | 275.2 | 0.7005 | 0 | 0.00732 |
| 971 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | Opt | 0.23 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | 0 | 0 |
| 972 | 0 | 6 | 4 | 0 | 294.2 | 0.7105 | Opt | 0.231 | 0 | 6 | 4 | 0 | 294.2 | 0.7016 | 0 | 3.4E-06 |
| 973 | 0 | 8 | 2 | 0 | 252.2 | 0.7188 | Opt | 0.23 | 0 | 8 | 2 | 0 | 252.2 | 0.7188 | 0.01 | 0 |
| 974 | 0 | 8 | 2 | 0 | 252.2 | 0.7159 | Opt | 0.451 | 0 | 8 | 2 | 0 | 252.2 | 0.7105 | 0 | 1.2E-05 |
| 975 | 0 | 7 | 3 | 0 | 273.2 | 0.7222 | Opt | 0.25 | 0 | 7 | 3 | 0 | 273.2 | 0.7222 | 0 | 0 |
| 976 | 0 | 7 | 3 | 0 | 273.2 | 0.7218 | Opt | 0.24 | 0 | 7 | 3 | 0 | 273.2 | 0.7144 | 0.01 | 7.3E-06 |
| 977 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.231 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0 | 0 |
| 978 | 0 | 9 | 1 | 1 | 233.1 | 0.7514 | Opt | 0.24 | 0 | 8 | 2 | 0 | 252.1 | 0.7577 | 0 | 0.08151 |
| 979 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.23 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0 | 0 |
| 980 | 0 | 6 | 4 | 0 | 294.1 | 0.7539 | Opt | 0.241 | 0 | 5 | 5 | 0 | 315.1 | 0.7593 | 0 | 0.0714 |
| 981 | 0 | 10 | 0 | 0 | 210.1 | 0.7911 | Opt | 0.23 | 0 | 10 | 0 | 0 | 210.1 | 0.7911 | 0 | 0 |
| 982 | 0 | 10 | 0 | 0 | 210.1 | 0.7871 | Opt | 0.22 | 0 | 10 | 0 | 0 | 210.1 | 0.774 | 0.01 | 9.5E-06 |
| 983 | 0 | 9 | 1 | 0 | 231.1 | 0.7631 | Opt | 0.241 | 0 | 9 | 1 | 0 | 231.1 | 0.7631 | 0.01 | 0 |
| 984 | 0 | 9 | 1 | 0 | 231.1 | 0.7608 | Opt | 0.32 | 0 | 9 | 1 | 2 | 235.1 | 0.7507 | 0 | 0.01731 |
| 985 | 0 | 6 | 4 | 0 | 294.1 | 0.7508 | Opt | 0.231 | 0 | 6 | 4 | 0 | 294.1 | 0.7508 | 0 | 0 |
| 986 | 0 | 6 | 4 | 1 | 296.1 | 0.7503 | Opt | 0.24 | 0 | 5 | 5 | 0 | 315.1 | 0.7757 | 0 | 0.06413 |
| 987 | 0 | 4 | 6 | 0 | 336.1 | 0.7809 | Opt | 1.452 | 0 | 4 | 6 | 0 | 336.1 | 0.7809 | 0 | 0 |
| 988 | 0 | 5 | 5 | 5 | 325.1 | 0.7501 | Opt | 0.611 | 0 | 4 | 6 | 0 | 336.1 | 0.7691 | 0 | 0.03381 |
| 989 | 0 | 7 | 3 | 0 | 273.2 | 0.755 | Opt | 0.22 | 0 | 7 | 3 | 0 | 273.2 | 0.755 | 0.01 | 0 |
| 990 | 0 | 7 | 3 | 0 | 273.2 | 0.7539 | Opt | 0.231 | 0 | 6 | 4 | 0 | 294.2 | 0.7795 | 0.01 | 0.07682 |
| 991 | 0 | 6 | 4 | 0 | 294.2 | 0.7558 | Opt | 0.24 | 0 | 6 | 4 | 0 | 294.2 | 0.7558 | 0 | 0 |
| 992 | 0 | 6 | 4 | 0 | 294.2 | 0.7544 | Opt | 0.23 | 0 | 5 | 5 | 0 | 315.2 | 0.7753 | 0 | 0.07133 |
| 993 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | Opt | 0.231 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | 0 | 0 |
| 994 | 0 | 10 | 0 | 0 | 210.1 | 0.714 | Opt | 0.29 | 0 | 10 | 0 | 3 | 216.1 | 0.7017 | 0.01 | 0.02856 |
| 995 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | Opt | 0.23 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | 0.01 | 0 |
| 996 | 0 | 8 | 2 | 0 | 252.1 | 0.7059 | Opt | 0.251 | 0 | 7 | 3 | 0 | 273.1 | 0.7144 | 0.01 | 0.08327 |
| 997 | 1 | 9 | 0 | 0 | 189.4 | 0.7276 | Opt | 0.23 | 1 | 9 | 0 | 0 | 189.4 | 0.7276 | 0 | 2.1E-05 |
| 998 | 1 | 9 | 0 | 0 | 189.4 | 0.7231 | Opt | 0.23 | 1 | 9 | 0 | 0 | 189.4 | 0.7111 | 0 | 3.7E-05 |
| 999 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | Opt | 0.231 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | 0 | 0 |
| ### | 0 | 10 | 0 | 0 | 210.2 | 0.7358 | Opt | 0.23 | 0 | 10 | 0 | 0 | 210.2 | 0.7242 | 0.01 | 1.4E-05 |
| ### | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | Opt | 0.23 | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | 0.01 | 0 |
| ### | 0 | 7 | 3 | 0 | 273.2 | 0.7088 | Opt | 0.231 | 0 | 7 | 3 | 1 | 275.2 | 0.7005 | 0.01 | 0.00733 |
| ### | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | Opt | 0.25 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | 0 | 0 |
| ### | 0 | 6 | 4 | 0 | 294.2 | 0.7105 | Opt | 0.23 | 0 | 6 | 4 | 0 | 294.2 | 0.7016 | 0 | 6.8E-06 |
| ### | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | Opt | 0.241 | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | 0 | 0 |
| ### | 0 | 8 | 2 | 0 | 252.3 | 0.7159 | Opt | 0.39 | 0 | 8 | 2 | 0 | 252.3 | 0.7105 | 0 | 2.8E-05 |
| ### | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | Opt | 0.251 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | 0 | 0 |
| ### | 0 | 7 | 3 | 0 | 273.3 | 0.7218 | Opt | 0.24 | 0 | 7 | 3 | 0 | 273.3 | 0.7144 | 0 | 1.5E-05 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1009 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1010 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1011 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1012 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1013 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1014 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1015 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1016 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1017 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1018 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1019 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1020 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1021 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1022 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1023 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1024 | 20 | 1 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1025 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1026 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1027 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1028 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1029 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1030 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1031 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1032 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1033 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1034 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1035 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1036 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1037 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1038 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1039 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1040 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1041 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1042 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1043 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1044 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1045 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1046 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1047 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1048 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1049 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1050 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1051 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1052 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1053 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1054 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1055 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1056 | 20 | 1 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| Exp # | Output Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1009 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.23 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0 | 0 |
| 1010 | 0 | 9 | 1 | 1 | 233.1 | 0.7514 | Opt | 0.241 | 0 | 8 | 2 | 0 | 252.1 | 0.7577 | 0.01 | 0.08149 |
| 1011 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.24 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0 | 0 |
| 1012 | 0 | 6 | 4 | 0 | 294.1 | 0.7539 | Opt | 0.24 | 0 | 5 | 5 | 0 | 315.1 | 0.7593 | 0 | 0.0714 |
| 1013 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | Opt | 0.231 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | 0.01 | 0 |
| 1014 | 0 | 10 | 0 | 0 | 210.2 | 0.7871 | Opt | 0.24 | 0 | 10 | 0 | 0 | 210.2 | 0.774 | 0 | 1.9E-05 |
| 1015 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | Opt | 0.24 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | 0 | 0 |
| 1016 | 0 | 9 | 1 | 0 | 231.2 | 0.7608 | Opt | 0.311 | 0 | 9 | 1 | 2 | 235.2 | 0.7507 | 0 | 0.01731 |
| 1017 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | Opt | 0.24 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | 0 | 0 |
| 1018 | 0 | 6 | 4 | 1 | 296.2 | 0.7503 | Opt | 0.241 | 0 | 5 | 5 | 0 | 315.2 | 0.7757 | 0 | 0.06409 |
| 1019 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | Opt | 1.372 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | 0 | 0 |
| 1020 | 0 | 5 | 5 | 5 | 325.2 | 0.7501 | Opt | 0.6 | 0 | 4 | 6 | 0 | 336.2 | 0.7691 | 0.01 | 0.03378 |
| 1021 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | Opt | 0.241 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | 0 | 0 |
| 1022 | 0 | 7 | 3 | 0 | 273.3 | 0.7539 | Opt | 0.23 | 0 | 6 | 4 | 0 | 294.3 | 0.7795 | 0 | 0.07675 |
| 1023 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | Opt | 0.24 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | 0.01 | 0 |
| 1024 | 0 | 6 | 4 | 0 | 294.3 | 0.7544 | Opt | 0.241 | 0 | 5 | 5 | 0 | 315.3 | 0.7753 | 0 | 0.07127 |
| 1025 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | Opt | 0.23 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | 0 | 0 |
| 1026 | 0 | 10 | 0 | 0 | 210.1 | 0.714 | Opt | 0.301 | 0 | 10 | 0 | 3 | 216.1 | 0.7017 | 0.01 | 0.02856 |
| 1027 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | Opt | 0.23 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | 0.01 | 0 |
| 1028 | 0 | 8 | 2 | 0 | 252.1 | 0.7059 | Opt | 0.29 | 0 | 7 | 3 | 0 | 273.1 | 0.7144 | 0 | 0.08328 |
| 1029 | 1 | 9 | 0 | 0 | 189.2 | 0.7276 | Opt | 0.231 | 1 | 9 | 0 | 0 | 189.2 | 0.7276 | 0 | 1.1E-05 |
| 1030 | 1 | 9 | 0 | 0 | 189.3 | 0.7231 | Opt | 0.23 | 1 | 9 | 0 | 0 | 189.3 | 0.7111 | 0.01 | 1.6E-05 |
| 1031 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | Opt | 0.23 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | 0.01 | 0 |
| 1032 | 0 | 10 | 0 | 0 | 210.2 | 0.7358 | Opt | 0.231 | 0 | 10 | 0 | 0 | 210.2 | 0.7242 | 0.01 | 9.5E-06 |
| 1033 | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | Opt | 0.24 | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | 0.01 | 0 |
| 1034 | 0 | 7 | 3 | 0 | 273.2 | 0.7088 | Opt | 0.24 | 0 | 7 | 3 | 1 | 275.2 | 0.7005 | 0 | 0.00732 |
| 1035 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | Opt | 0.231 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | 0.01 | 0 |
| 1036 | 0 | 6 | 4 | 0 | 294.2 | 0.7105 | Opt | 0.23 | 0 | 6 | 4 | 0 | 294.2 | 0.7016 | 0.01 | 3.4E-06 |
| 1037 | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | Opt | 0.24 | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | 0 | 0 |
| 1038 | 0 | 8 | 2 | 0 | 252.3 | 0.7182 | Opt | 0.271 | 0 | 8 | 2 | 0 | 252.3 | 0.7105 | 0 | 7.9E-06 |
| 1039 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | Opt | 0.27 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | 0 | 0 |
| 1040 | 0 | 7 | 3 | 0 | 273.3 | 0.7218 | Opt | 0.281 | 0 | 7 | 3 | 0 | 273.3 | 0.7144 | 0 | 7.3E-06 |
| 1041 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.24 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0 | 0 |
| 1042 | 0 | 9 | 1 | 1 | 233.1 | 0.7514 | Opt | 0.25 | 0 | 8 | 2 | 0 | 252.1 | 0.7577 | 0 | 0.08149 |
| 1043 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.231 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0.01 | 0 |
| 1044 | 0 | 6 | 4 | 0 | 294.1 | 0.7539 | Opt | 0.24 | 0 | 5 | 5 | 0 | 315.1 | 0.7593 | 0.01 | 0.07139 |
| 1045 | 0 | 10 | 0 | 0 | 210.1 | 0.7911 | Opt | 0.24 | 0 | 10 | 0 | 0 | 210.1 | 0.7911 | 0.01 | 0 |
| 1046 | 0 | 10 | 0 | 0 | 210.2 | 0.7871 | Opt | 0.231 | 0 | 10 | 0 | 0 | 210.2 | 0.774 | 0 | 4.8E-06 |
| 1047 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | Opt | 0.24 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | 0.01 | 0 |
| 1048 | 0 | 9 | 1 | 0 | 231.2 | 0.7608 | Opt | 0.311 | 0 | 9 | 1 | 2 | 235.2 | 0.7507 | 0 | 0.01731 |
| 1049 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | Opt | 0.24 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | 0 | 0 |
| 1050 | 0 | 6 | 4 | 1 | 296.2 | 0.7503 | Opt | 0.25 | 0 | 5 | 5 | 0 | 315.2 | 0.7757 | 0 | 0.0641 |
| 1051 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | Opt | 6.6 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | 0.01 | 0 |
| 1052 | 0 | 5 | 5 | 5 | 325.2 | 0.7501 | Opt | 0.34 | 0 | 4 | 6 | 0 | 336.2 | 0.7691 | 0.01 | 0.03379 |
| 1053 | 0 | 7 | 3 | 0 | 273.2 | 0.755 | Opt | 0.231 | 0 | 7 | 3 | 0 | 273.2 | 0.755 | 0.01 | 0 |
| 1054 | 0 | 7 | 3 | 0 | 273.2 | 0.7539 | Opt | 0.23 | 0 | 6 | 4 | 0 | 294.2 | 0.7795 | 0.01 | 0.07679 |
| 1055 | 0 | 6 | 4 | 0 | 294.2 | 0.7558 | Opt | 0.24 | 0 | 6 | 4 | 0 | 294.2 | 0.7558 | 0.01 | 0 |
| 1056 | 0 | 6 | 4 | 0 | 294.2 | 0.7544 | Opt | 0.231 | 0 | 5 | 5 | 0 | 315.2 | 0.7753 | 0.01 | 0.07131 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1057 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1058 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1059 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1060 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1061 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1062 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1063 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1064 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1065 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1066 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1067 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1068 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1069 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1070 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1071 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1072 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1073 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1074 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1075 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1076 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1077 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1078 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1079 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1080 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1081 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1082 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1083 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1084 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1085 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1086 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1087 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1088 | 20 | 1 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1089 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1090 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1091 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1092 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1093 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1094 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1095 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1096 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1097 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1098 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1099 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1100 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1101 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1102 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1103 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1104 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 1057 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | Opt | 0.24 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | 0.01 | 0 |
| 1058 | 0 | 10 | 0 | 0 | 210.1 | 0.714 | Opt | 0.361 | 0 | 10 | 0 | 3 | 216.1 | 0.7017 | 0 | 0.02856 |
| 1059 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | Opt | 0.25 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | 0 | 0 |
| 1060 | 0 | 8 | 2 | 0 | 252.1 | 0.7053 | Opt | 0.31 | 0 | 7 | 3 | 0 | 273.1 | 0.7144 | 0 | 0.08326 |
| 1061 | 1 | 9 | 0 | 0 | 189.4 | 0.7276 | Opt | 0.241 | 1 | 9 | 0 | 0 | 189.4 | 0.7276 | 0 | 2.1E-05 |
| 1062 | 1 | 9 | 0 | 0 | 189.4 | 0.7231 | Opt | 0.24 | 1 | 9 | 0 | 0 | 189.4 | 0.7111 | 0 | 3.7E-05 |
| 1063 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | Opt | 0.24 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | 0.01 | 0 |
| 1064 | 0 | 10 | 0 | 0 | 210.2 | 0.7358 | Opt | 0.241 | 0 | 10 | 0 | 0 | 210.2 | 0.7242 | 0 | 1.4E-05 |
| 1065 | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | Opt | 0.25 | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | 0.01 | 0 |
| 1066 | 0 | 7 | 3 | 0 | 273.2 | 0.7088 | Opt | 0.25 | 0 | 7 | 3 | 1 | 275.2 | 0.7005 | 0.01 | 0.00733 |
| 1067 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | Opt | 0.24 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | 0.011 | 0 |
| 1068 | 0 | 6 | 4 | 0 | 294.2 | 0.7105 | Opt | 0.25 | 0 | 6 | 4 | 0 | 294.2 | 0.7016 | 0.01 | 1E-05 |
| 1069 | 0 | 8 | 2 | 0 | 252.4 | 0.7188 | Opt | 0.241 | 0 | 8 | 2 | 0 | 252.4 | 0.7188 | 0 | 0 |
| 1070 | 0 | 8 | 2 | 0 | 252.4 | 0.7159 | Opt | 0.36 | 0 | 8 | 2 | 0 | 252.4 | 0.7105 | 0.01 | 2.4E-05 |
| 1071 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | Opt | 0.281 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | 0 | 0 |
| 1072 | 0 | 7 | 3 | 0 | 273.4 | 0.7218 | Opt | 0.3 | 0 | 7 | 3 | 0 | 273.4 | 0.7144 | 0 | 1.1E-05 |
| 1073 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.24 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0.01 | 0 |
| 1074 | 0 | 9 | 1 | 1 | 233.1 | 0.7514 | Opt | 0.261 | 0 | 8 | 2 | 0 | 252.1 | 0.7577 | 0 | 0.08147 |
| 1075 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.24 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0 | 0 |
| 1076 | 0 | 6 | 4 | 0 | 294.1 | 0.7539 | Opt | 0.25 | 0 | 5 | 5 | 0 | 315.1 | 0.7593 | 0 | 0.07139 |
| 1077 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | Opt | 0.241 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | 0.01 | 0 |
| 1078 | 0 | 10 | 0 | 0 | 210.2 | 0.7871 | Opt | 0.24 | 0 | 10 | 0 | 0 | 210.2 | 0.774 | 0.01 | 1.4E-05 |
| 1079 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | Opt | 0.25 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | 0 | 0 |
| 1080 | 0 | 9 | 1 | 0 | 231.2 | 0.7608 | Opt | 0.331 | 0 | 9 | 1 | 2 | 235.2 | 0.7507 | 0 | 0.01731 |
| 1081 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | Opt | 0.24 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | 0 | 0 |
| 1082 | 0 | 6 | 4 | 1 | 296.2 | 0.7503 | Opt | 0.251 | 0 | 5 | 5 | 0 | 315.2 | 0.7757 | 0.01 | 0.06407 |
| 1083 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | Opt | 2.353 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | 0 | 0 |
| 1084 | 0 | 5 | 5 | 5 | 325.2 | 0.7501 | Opt | 0.491 | 0 | 4 | 6 | 0 | 336.2 | 0.7691 | 0.01 | 0.03376 |
| 1085 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | Opt | 0.25 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | 0 | 0 |
| 1086 | 0 | 7 | 3 | 0 | 273.3 | 0.7539 | Opt | 0.24 | 0 | 6 | 4 | 0 | 294.3 | 0.7795 | 0 | 0.07672 |
| 1087 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | Opt | 0.251 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | 0.01 | 0 |
| 1088 | 0 | 6 | 4 | 0 | 294.3 | 0.7544 | Opt | 0.25 | 0 | 5 | 5 | 0 | 315.3 | 0.7753 | 0 | 0.07125 |
| 1089 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | Opt | 0.251 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | 0 | 0 |
| 1090 | 0 | 10 | 0 | 0 | 210.1 | 0.714 | Opt | 0.28 | 0 | 10 | 0 | 3 | 216.1 | 0.7017 | 0 | 0.02855 |
| 1091 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | Opt | 0.25 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | 0 | 0 |
| 1092 | 0 | 8 | 2 | 0 | 252.1 | 0.7059 | Opt | 0.351 | 0 | 7 | 3 | 0 | 273.1 | 0.7144 | 0 | 0.08327 |
| 1093 | 1 | 9 | 0 | 0 | 189.3 | 0.7276 | Opt | 0.24 | 1 | 9 | 0 | 0 | 189.3 | 0.7276 | 0 | 1.1E-05 |
| 1094 | 1 | 9 | 0 | 0 | 189.3 | 0.7231 | Opt | 0.241 | 1 | 9 | 0 | 0 | 189.3 | 0.7111 | 0.01 | 2.1E-05 |
| 1095 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | Opt | 0.25 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | 0 | 0 |
| 1096 | 0 | 10 | 0 | 0 | 210.2 | 0.7358 | Opt | 0.25 | 0 | 10 | 0 | 0 | 210.2 | 0.7242 | 0 | 9.5E-06 |
| 1097 | 0 | 7 | 3 | 0 | 273.3 | 0.7084 | Opt | 0.251 | 0 | 7 | 3 | 0 | 273.3 | 0.7084 | 0 | 0 |
| 1098 | 0 | 7 | 3 | 0 | 273.3 | 0.7088 | Opt | 0.25 | 0 | 7 | 3 | 1 | 275.3 | 0.7005 | 0 | 0.00732 |
| 1099 | 0 | 6 | 4 | 0 | 294.3 | 0.7106 | Opt | 0.25 | 0 | 6 | 4 | 0 | 294.3 | 0.7106 | 0 | 0 |
| 1100 | 0 | 6 | 4 | 0 | 294.3 | 0.7105 | Opt | 0.251 | 0 | 6 | 4 | 0 | 294.3 | 0.7016 | 0 | 3.4E-06 |
| 1101 | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | Opt | 0.25 | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | 0.01 | 0 |
| 1102 | 0 | 8 | 2 | 0 | 252.4 | 0.7159 | Opt | 0.461 | 0 | 8 | 2 | 0 | 252.4 | 0.7105 | 0 | 7.9E-06 |
| 1103 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | Opt | 0.27 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | 0.01 | 0 |
| 1104 | 0 | 7 | 3 | 0 | 273.4 | 0.7218 | Opt | 0.261 | 0 | 7 | 3 | 0 | 273.4 | 0.7144 | 0.01 | 3.7E-06 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1105 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1106 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1107 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1108 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1109 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1110 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1111 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1112 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1113 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1114 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1115 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1116 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1117 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1118 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1119 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1120 | 20 | 1 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1121 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1122 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1123 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1124 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1125 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1126 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1127 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1128 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1129 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1130 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1131 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1132 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1133 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1134 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1135 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1136 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1137 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1138 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1139 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1140 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1141 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1142 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1143 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1144 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1145 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1146 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1147 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1148 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1149 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1150 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1151 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1152 | 20 | 1 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 1105 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.24 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0 | 0 |
| 1106 | 0 | 9 | 1 | 1 | 233.1 | 0.7514 | Opt | 0.26 | 0 | 8 | 2 | 0 | 252.1 | 0.7577 | 0 | 0.08149 |
| 1107 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.241 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0.01 | 0 |
| 1108 | 0 | 6 | 4 | 0 | 294.1 | 0.7539 | Opt | 0.26 | 0 | 5 | 5 | 0 | 315.1 | 0.7593 | 0 | 0.07139 |
| 1109 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | Opt | 0.25 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | 0 | 0 |
| 1110 | 0 | 10 | 0 | 0 | 210.2 | 0.7871 | Opt | 0.251 | 0 | 10 | 0 | 0 | 210.2 | 0.774 | 0 | 9.5E-06 |
| 1111 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | Opt | 0.26 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | 0 | 0 |
| 1112 | 0 | 9 | 1 | 0 | 231.2 | 0.7608 | Opt | 0.341 | 0 | 9 | 1 | 2 | 235.2 | 0.7507 | 0 | 0.0173 |
| 1113 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | Opt | 0.24 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | 0.01 | 0 |
| 1114 | 0 | 6 | 4 | 1 | 296.2 | 0.7503 | Opt | 0.25 | 0 | 5 | 5 | 0 | 315.2 | 0.7757 | 0.01 | 0.06411 |
| 1115 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | Opt | 1.743 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | 0.01 | 0 |
| 1116 | 0 | 5 | 5 | 5 | 325.3 | 0.7501 | Opt | 0.631 | 0 | 4 | 6 | 0 | 336.2 | 0.7691 | 0.01 | 0.03379 |
| 1117 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | Opt | 0.25 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | 0 | 0 |
| 1118 | 0 | 7 | 3 | 0 | 273.3 | 0.7539 | Opt | 0.25 | 0 | 6 | 4 | 0 | 294.3 | 0.7795 | 0.01 | 0.07678 |
| 1119 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | Opt | 0.251 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | 0 | 0 |
| 1120 | 0 | 6 | 4 | 0 | 294.3 | 0.7544 | Opt | 0.24 | 0 | 5 | 5 | 0 | 315.3 | 0.7753 | 0.01 | 0.0713 |
| 1121 | 0 | 10 | 0 | 0 | 210.2 | 0.7148 | Opt | 0.251 | 0 | 10 | 0 | 0 | 210.2 | 0.7148 | 0.01 | 0 |
| 1122 | 0 | 10 | 0 | 0 | 210.2 | 0.714 | Opt | 0.32 | 0 | 10 | 0 | 3 | 216.2 | 0.7017 | 0 | 0.02855 |
| 1123 | 0 | 8 | 2 | 0 | 252.2 | 0.7048 | Opt | 0.25 | 0 | 8 | 2 | 0 | 252.2 | 0.7048 | 0.01 | 0 |
| 1124 | 0 | 8 | 2 | 0 | 252.2 | 0.7053 | Opt | 0.331 | 0 | 7 | 3 | 0 | 273.2 | 0.7144 | 0 | 0.08325 |
| 1125 | 1 | 9 | 0 | 0 | 189.5 | 0.7276 | Opt | 0.25 | 1 | 9 | 0 | 0 | 189.5 | 0.7276 | 0 | 2.1E-05 |
| 1126 | 1 | 9 | 0 | 0 | 189.5 | 0.7231 | Opt | 0.261 | 1 | 9 | 0 | 0 | 189.5 | 0.7111 | 0 | 3.7E-05 |
| 1127 | 0 | 10 | 0 | 0 | 210.3 | 0.7378 | Opt | 0.25 | 0 | 10 | 0 | 0 | 210.3 | 0.7378 | 0 | 0 |
| 1128 | 0 | 10 | 0 | 0 | 210.3 | 0.7358 | Opt | 0.25 | 0 | 10 | 0 | 0 | 210.3 | 0.7242 | 0.01 | 1.4E-05 |
| 1129 | 0 | 7 | 3 | 0 | 273.3 | 0.7084 | Opt | 0.271 | 0 | 7 | 3 | 0 | 273.3 | 0.7084 | 0 | 0 |
| 1130 | 0 | 7 | 3 | 0 | 273.3 | 0.7088 | Opt | 0.25 | 0 | 7 | 3 | 1 | 275.3 | 0.7005 | 0 | 0.00732 |
| 1131 | 0 | 6 | 4 | 0 | 294.3 | 0.7106 | Opt | 0.26 | 0 | 6 | 4 | 0 | 294.3 | 0.7106 | 0.01 | 0 |
| 1132 | 0 | 6 | 4 | 0 | 294.3 | 0.7105 | Opt | 0.261 | 0 | 6 | 4 | 0 | 294.3 | 0.7016 | 0 | 6.8E-06 |
| 1133 | 0 | 8 | 2 | 0 | 252.4 | 0.7188 | Opt | 0.25 | 0 | 8 | 2 | 0 | 252.4 | 0.7188 | 0 | 0 |
| 1134 | 0 | 8 | 2 | 0 | 252.4 | 0.7159 | Opt | 0.491 | 0 | 8 | 2 | 0 | 252.5 | 0.7105 | 0.01 | 2.4E-05 |
| 1135 | 0 | 7 | 3 | 0 | 273.4 | 0.7222 | Opt | 0.29 | 0 | 7 | 3 | 0 | 273.4 | 0.7222 | 0 | 0 |
| 1136 | 0 | 7 | 3 | 0 | 273.4 | 0.7218 | Opt | 0.261 | 0 | 7 | 3 | 0 | 273.5 | 0.7144 | 0.01 | 1.5E-05 |
| 1137 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.25 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0 | 0 |
| 1138 | 0 | 9 | 1 | 1 | 233.2 | 0.7514 | Opt | 0.27 | 0 | 8 | 2 | 0 | 252.2 | 0.7577 | 0 | 0.08146 |
| 1139 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.251 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0 | 0 |
| 1140 | 0 | 6 | 4 | 0 | 294.2 | 0.7539 | Opt | 0.26 | 0 | 5 | 5 | 0 | 315.2 | 0.7593 | 0.01 | 0.07138 |
| 1141 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | Opt | 0.261 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | 0 | 0 |
| 1142 | 0 | 10 | 0 | 0 | 210.3 | 0.7871 | Opt | 0.25 | 0 | 10 | 0 | 0 | 210.3 | 0.774 | 0 | 1.9E-05 |
| 1143 | 0 | 9 | 1 | 0 | 231.3 | 0.7631 | Opt | 0.25 | 0 | 9 | 1 | 0 | 231.3 | 0.7631 | 0.01 | 0 |
| 1144 | 0 | 9 | 1 | 0 | 231.3 | 0.7608 | Opt | 0.351 | 0 | 9 | 1 | 2 | 235.3 | 0.7507 | 0 | 0.0173 |
| 1145 | 0 | 6 | 4 | 0 | 294.3 | 0.7508 | Opt | 0.25 | 0 | 6 | 4 | 0 | 294.3 | 0.7508 | 0 | 0 |
| 1146 | 0 | 6 | 4 | 1 | 296.3 | 0.7503 | Opt | 0.261 | 0 | 5 | 5 | 0 | 315.3 | 0.7757 | 0.01 | 0.06407 |
| 1147 | 0 | 4 | 6 | 0 | 336.3 | 0.7809 | Opt | 1.291 | 0 | 4 | 6 | 0 | 336.3 | 0.7809 | 0 | 0 |
| 1148 | 0 | 5 | 5 | 5 | 325.3 | 0.7501 | Opt | 0.631 | 0 | 4 | 6 | 0 | 336.3 | 0.7691 | 0.01 | 0.03377 |
| 1149 | 0 | 7 | 3 | 0 | 273.4 | 0.755 | Opt | 0.251 | 0 | 7 | 3 | 0 | 273.4 | 0.755 | 0 | 0 |
| 1150 | 0 | 7 | 3 | 0 | 273.4 | 0.7539 | Opt | 0.25 | 0 | 6 | 4 | 0 | 294.4 | 0.7795 | 0.01 | 0.07671 |
| 1151 | 0 | 6 | 4 | 0 | 294.4 | 0.7558 | Opt | 0.25 | 0 | 6 | 4 | 0 | 294.4 | 0.7558 | 0.01 | 0 |
| 1152 | 0 | 6 | 4 | 0 | 294.4 | 0.7544 | Opt | 0.25 | 0 | 5 | 5 | 0 | 315.4 | 0.7753 | 0.011 | 0.07124 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1153 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1154 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1155 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1156 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1157 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1158 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1159 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1160 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1161 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1162 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1163 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1164 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1165 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1166 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1167 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1168 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1169 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1170 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1171 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1172 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1173 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1174 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1175 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1176 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1177 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1178 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1179 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1180 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1181 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1182 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1183 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1184 | 20 | 2 | 0.5 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1185 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1186 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1187 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1188 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1189 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1190 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1191 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1192 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1193 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1194 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1195 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1196 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1197 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1198 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1199 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1200 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 1153 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | Opt | 0.26 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | 0 | 0 |
| 1154 | 0 | 10 | 0 | 0 | 205.1 | 0.714 | Opt | 0.301 | 0 | 10 | 0 | 3 | 212.6 | 0.7017 | 0 | 0.03658 |
| 1155 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | Opt | 0.26 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | 0 | 0 |
| 1156 | 0 | 8 | 2 | 0 | 246.1 | 0.7059 | Opt | 0.28 | 0 | 7 | 3 | 0 | 266.6 | 0.7144 | 0 | 0.08329 |
| 1157 | 1 | 9 | 0 | 0 | 184.7 | 0.7276 | Opt | 0.251 | 1 | 9 | 0 | 0 | 184.7 | 0.7276 | 0.01 | 1.1E-05 |
| 1158 | 1 | 9 | 0 | 0 | 184.7 | 0.7231 | Opt | 0.25 | 1 | 9 | 0 | 0 | 184.7 | 0.7111 | 0 | 1.6E-05 |
| 1159 | 0 | 10 | 0 | 0 | 205.1 | 0.7378 | Opt | 0.271 | 0 | 10 | 0 | 0 | 205.1 | 0.7378 | 0.01 | 0 |
| 1160 | 0 | 10 | 0 | 0 | 205.1 | 0.7358 | Opt | 0.25 | 0 | 10 | 0 | 0 | 205.1 | 0.7242 | 0 | 9.7E-06 |
| 1161 | 0 | 7 | 3 | 0 | 266.6 | 0.7084 | Opt | 0.26 | 0 | 7 | 3 | 0 | 266.6 | 0.7084 | 0.01 | 0 |
| 1162 | 0 | 7 | 3 | 0 | 266.7 | 0.7088 | Opt | 0.251 | 0 | 7 | 3 | 1 | 269.2 | 0.7005 | 0.01 | 0.00938 |
| 1163 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | Opt | 0.26 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | 0 | 0 |
| 1164 | 0 | 6 | 4 | 0 | 287.2 | 0.7105 | Opt | 0.26 | 0 | 6 | 4 | 0 | 287.2 | 0.7016 | 0 | 3.5E-06 |
| 1165 | 0 | 8 | 2 | 0 | 246.2 | 0.7188 | Opt | 0.261 | 0 | 8 | 2 | 0 | 246.2 | 0.7188 | 0 | 0 |
| 1166 | 0 | 8 | 2 | 0 | 246.2 | 0.7182 | Opt | 0.26 | 0 | 8 | 2 | 0 | 246.2 | 0.7105 | 0 | 8.1E-06 |
| 1167 | 0 | 7 | 3 | 0 | 266.7 | 0.7222 | Opt | 0.291 | 0 | 7 | 3 | 0 | 266.7 | 0.7222 | 0.01 | 0 |
| 1168 | 0 | 7 | 3 | 0 | 266.7 | 0.7218 | Opt | 0.36 | 0 | 7 | 3 | 0 | 266.7 | 0.7144 | 0 | 7.5E-06 |
| 1169 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.251 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0.01 | 0 |
| 1170 | 0 | 9 | 1 | 1 | 228.1 | 0.7514 | Opt | 0.26 | 0 | 8 | 2 | 0 | 246.1 | 0.7577 | 0.01 | 0.07891 |
| 1171 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.25 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0.01 | 0 |
| 1172 | 0 | 6 | 4 | 0 | 287.1 | 0.7539 | Opt | 0.261 | 0 | 5 | 5 | 0 | 307.6 | 0.7593 | 0 | 0.0714 |
| 1173 | 0 | 10 | 0 | 0 | 205.1 | 0.7911 | Opt | 0.25 | 0 | 10 | 0 | 0 | 205.1 | 0.7911 | 0.01 | 0 |
| 1174 | 0 | 10 | 0 | 0 | 205.1 | 0.7871 | Opt | 0.25 | 0 | 10 | 0 | 0 | 205.1 | 0.774 | 0.01 | 9.7E-06 |
| 1175 | 0 | 9 | 1 | 0 | 225.6 | 0.7631 | Opt | 0.261 | 0 | 9 | 1 | 0 | 225.6 | 0.7631 | 0 | 0 |
| 1176 | 0 | 9 | 1 | 0 | 225.6 | 0.7608 | Opt | 0.31 | 0 | 9 | 1 | 2 | 230.6 | 0.7507 | 0 | 0.02216 |
| 1177 | 0 | 6 | 4 | 0 | 287.1 | 0.7508 | Opt | 0.251 | 0 | 6 | 4 | 0 | 287.1 | 0.7508 | 0.01 | 0 |
| 1178 | 0 | 6 | 4 | 1 | 289.6 | 0.7503 | Opt | 0.26 | 0 | 5 | 5 | 0 | 307.6 | 0.7757 | 0.01 | 0.06211 |
| 1179 | 0 | 4 | 6 | 0 | 328.1 | 0.7809 | Opt | 2.193 | 0 | 4 | 6 | 0 | 328.1 | 0.7809 | 0.01 | 0 |
| 1180 | 0 | 5 | 5 | 5 | 320.1 | 0.7501 | Opt | 0.431 | 0 | 4 | 6 | 0 | 328.1 | 0.7691 | 0 | 0.02496 |
| 1181 | 0 | 7 | 3 | 0 | 266.7 | 0.755 | Opt | 0.26 | 0 | 7 | 3 | 0 | 266.7 | 0.755 | 0 | 0 |
| 1182 | 0 | 7 | 3 | 0 | 266.7 | 0.7539 | Opt | 0.261 | 0 | 6 | 4 | 0 | 287.2 | 0.7795 | 0 | 0.07681 |
| 1183 | 0 | 6 | 4 | 0 | 287.2 | 0.7558 | Opt | 0.26 | 0 | 6 | 4 | 0 | 287.2 | 0.7558 | 0.01 | 0 |
| 1184 | 0 | 6 | 4 | 0 | 287.2 | 0.7544 | Opt | 0.26 | 0 | 5 | 5 | 0 | 307.7 | 0.7753 | 0 | 0.07133 |
| 1185 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | Opt | 0.261 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | 0 | 0 |
| 1186 | 0 | 10 | 0 | 0 | 205.1 | 0.714 | Opt | 0.29 | 0 | 10 | 0 | 3 | 212.6 | 0.7017 | 0 | 0.03657 |
| 1187 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | Opt | 0.26 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | 0 | 0 |
| 1188 | 0 | 8 | 2 | 0 | 246.1 | 0.7059 | Opt | 0.271 | 0 | 7 | 3 | 0 | 266.6 | 0.7144 | 0.01 | 0.08327 |
| 1189 | 1 | 9 | 0 | 0 | 184.9 | 0.7276 | Opt | 0.25 | 1 | 9 | 0 | 0 | 184.9 | 0.7276 | 0.01 | 2.2E-05 |
| 1190 | 1 | 9 | 0 | 0 | 184.9 | 0.7231 | Opt | 0.251 | 1 | 9 | 0 | 0 | 184.9 | 0.7111 | 0.01 | 3.8E-05 |
| 1191 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | Opt | 0.27 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | 0.01 | 0 |
| 1192 | 0 | 10 | 0 | 0 | 205.2 | 0.7358 | Opt | 0.27 | 0 | 10 | 0 | 0 | 205.2 | 0.7242 | 0 | 1.5E-05 |
| 1193 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | Opt | 0.271 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | 0 | 0 |
| 1194 | 0 | 7 | 3 | 0 | 266.7 | 0.7088 | Opt | 0.25 | 0 | 7 | 3 | 1 | 269.2 | 0.7005 | 0.01 | 0.00938 |
| 1195 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | Opt | 0.261 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | 0.01 | 0 |
| 1196 | 0 | 6 | 4 | 0 | 287.2 | 0.7105 | Opt | 0.26 | 0 | 6 | 4 | 0 | 287.2 | 0.7016 | 0 | 7E-06 |
| 1197 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | Opt | 0.26 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | 0.01 | 0 |
| 1198 | 0 | 8 | 2 | 0 | 246.3 | 0.7159 | Opt | 0.351 | 0 | 8 | 2 | 0 | 246.3 | 0.7105 | 0 | 2.8E-05 |
| 1199 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | Opt | 0.29 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | 0.01 | 0 |
| 1200 | 0 | 7 | 3 | 0 | 266.8 | 0.7218 | Opt | 0.271 | 0 | 7 | 3 | 0 | 266.8 | 0.7144 | 0 | 1.5E-05 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1201 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1202 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1203 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1204 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1205 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1206 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1207 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1208 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1209 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1210 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1211 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1212 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1213 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1214 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1215 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1216 | 20 | 2 | 0.5 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1217 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1218 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1219 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1220 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1221 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1222 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1223 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1224 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1225 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1226 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1227 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1228 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1229 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1230 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1231 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1232 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1233 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1234 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1235 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1236 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1237 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1238 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1239 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1240 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1241 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1242 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1243 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1244 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1245 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1246 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1247 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1248 | 20 | 2 | 0.5 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 1201 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.26 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0 | 0 |
| 1202 | 0 | 9 | 1 | 1 | 228.1 | 0.7514 | Opt | 0.27 | 0 | 8 | 2 | 0 | 246.1 | 0.7577 | 0.01 | 0.07889 |
| 1203 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.251 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0.01 | 0 |
| 1204 | 0 | 6 | 4 | 0 | 287.1 | 0.7539 | Opt | 0.26 | 0 | 5 | 5 | 0 | 307.6 | 0.7593 | 0.01 | 0.0714 |
| 1205 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | Opt | 0.271 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | 0 | 0 |
| 1206 | 0 | 10 | 0 | 0 | 205.2 | 0.7871 | Opt | 0.26 | 0 | 10 | 0 | 0 | 205.2 | 0.774 | 0 | 1.9E-05 |
| 1207 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | Opt | 0.26 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | 0.01 | 0 |
| 1208 | 0 | 9 | 1 | 0 | 225.7 | 0.7608 | Opt | 0.311 | 0 | 9 | 1 | 2 | 230.7 | 0.7507 | 0 | 0.02217 |
| 1209 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | Opt | 0.26 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | 0 | 0 |
| 1210 | 0 | 6 | 4 | 1 | 289.7 | 0.7503 | Opt | 0.271 | 0 | 5 | 5 | 0 | 307.7 | 0.7757 | 0 | 0.06208 |
| 1211 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | Opt | 2.383 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | 0.01 | 0 |
| 1212 | 0 | 5 | 5 | 5 | 320.2 | 0.7501 | Opt | 0.681 | 0 | 4 | 6 | 0 | 328.2 | 0.7691 | 0 | 0.02494 |
| 1213 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | Opt | 0.26 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | 0 | 0 |
| 1214 | 0 | 7 | 3 | 0 | 266.8 | 0.7539 | Opt | 0.271 | 0 | 6 | 4 | 0 | 287.3 | 0.7795 | 0 | 0.07675 |
| 1215 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | Opt | 0.26 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | 0 | 0 |
| 1216 | 0 | 6 | 4 | 0 | 287.3 | 0.7544 | Opt | 0.26 | 0 | 5 | 5 | 0 | 307.8 | 0.7753 | 0.01 | 0.07127 |
| 1217 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | Opt | 0.261 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | 0 | 0 |
| 1218 | 0 | 10 | 0 | 0 | 205.1 | 0.714 | Opt | 0.3 | 0 | 10 | 0 | 3 | 212.6 | 0.7017 | 0.01 | 0.03657 |
| 1219 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | Opt | 0.271 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | 0 | 0 |
| 1220 | 0 | 8 | 2 | 0 | 246.1 | 0.7059 | Opt | 0.28 | 0 | 7 | 3 | 0 | 266.6 | 0.7144 | 0 | 0.08328 |
| 1221 | 1 | 9 | 0 | 0 | 184.7 | 0.7276 | Opt | 0.26 | 1 | 9 | 0 | 0 | 184.7 | 0.7276 | 0 | 1.1E-05 |
| 1222 | 1 | 9 | 0 | 0 | 184.8 | 0.7231 | Opt | 0.261 | 1 | 9 | 0 | 0 | 184.8 | 0.7111 | 0 | 1.6E-05 |
| 1223 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | Opt | 0.27 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | 0 | 0 |
| 1224 | 0 | 10 | 0 | 0 | 205.2 | 0.7358 | Opt | 0.271 | 0 | 10 | 0 | 0 | 205.2 | 0.7242 | 0 | 9.7E-06 |
| 1225 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | Opt | 0.27 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | 0.01 | 0 |
| 1226 | 0 | 7 | 3 | 0 | 266.7 | 0.7088 | Opt | 0.27 | 0 | 7 | 3 | 1 | 269.2 | 0.7005 | 0 | 0.00938 |
| 1227 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | Opt | 0.281 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | 0 | 0 |
| 1228 | 0 | 6 | 4 | 0 | 287.2 | 0.7105 | Opt | 0.28 | 0 | 6 | 4 | 0 | 287.2 | 0.7016 | 0 | 3.5E-06 |
| 1229 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | Opt | 0.271 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | 0 | 0 |
| 1230 | 0 | 8 | 2 | 0 | 246.3 | 0.7182 | Opt | 0.28 | 0 | 8 | 2 | 0 | 246.3 | 0.7105 | 0 | 8.1E-06 |
| 1231 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | Opt | 0.31 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | 0 | 0 |
| 1232 | 0 | 7 | 3 | 0 | 266.8 | 0.7218 | Opt | 0.351 | 0 | 7 | 3 | 0 | 266.8 | 0.7144 | 0 | 7.5E-06 |
| 1233 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.26 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0 | 0 |
| 1234 | 0 | 9 | 1 | 1 | 228.1 | 0.7514 | Opt | 0.271 | 0 | 8 | 2 | 0 | 246.1 | 0.7577 | 0.01 | 0.07889 |
| 1235 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.26 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0.01 | 0 |
| 1236 | 0 | 6 | 4 | 0 | 287.1 | 0.7539 | Opt | 0.261 | 0 | 5 | 5 | 0 | 307.6 | 0.7593 | 0.01 | 0.07139 |
| 1237 | 0 | 10 | 0 | 0 | 205.1 | 0.7911 | Opt | 0.26 | 0 | 10 | 0 | 0 | 205.1 | 0.7911 | 0.01 | 0 |
| 1238 | 0 | 10 | 0 | 0 | 205.2 | 0.7871 | Opt | 0.27 | 0 | 10 | 0 | 0 | 205.2 | 0.774 | 0 | 4.9E-06 |
| 1239 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | Opt | 0.271 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | 0 | 0 |
| 1240 | 0 | 9 | 1 | 0 | 225.7 | 0.7608 | Opt | 0.31 | 0 | 9 | 1 | 2 | 230.7 | 0.7507 | 0 | 0.02216 |
| 1241 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | Opt | 0.261 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | 0 | 0 |
| 1242 | 0 | 6 | 4 | 1 | 289.7 | 0.7503 | Opt | 0.27 | 0 | 5 | 5 | 0 | 307.7 | 0.7757 | 0.01 | 0.06209 |
| 1243 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | Opt | 2.233 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | 0 | 0 |
| 1244 | 0 | 5 | 5 | 5 | 320.2 | 0.7501 | Opt | 1.232 | 0 | 4 | 6 | 0 | 328.2 | 0.7691 | 0 | 0.02495 |
| 1245 | 0 | 7 | 3 | 0 | 266.7 | 0.755 | Opt | 0.26 | 0 | 7 | 3 | 0 | 266.7 | 0.755 | 0.01 | 0 |
| 1246 | 0 | 7 | 3 | 0 | 266.7 | 0.7539 | Opt | 0.261 | 0 | 6 | 4 | 0 | 287.2 | 0.7795 | 0.01 | 0.07678 |
| 1247 | 0 | 6 | 4 | 0 | 287.2 | 0.7558 | Opt | 0.27 | 0 | 6 | 4 | 0 | 287.2 | 0.7558 | 0.01 | 0 |
| 1248 | 0 | 6 | 4 | 0 | 287.2 | 0.7544 | Opt | 0.27 | 0 | 5 | 5 | 0 | 307.7 | 0.7753 | 0 | 0.07131 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1249 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1250 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1251 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1252 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1253 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1254 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1255 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1256 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1257 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1258 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1259 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1260 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1261 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1262 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1263 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1264 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1265 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1266 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1267 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1268 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1269 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1270 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1271 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1272 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1273 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1274 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1275 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1276 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1277 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1278 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1279 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1280 | 20 | 2 | 0.5 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1281 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1282 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1283 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1284 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1285 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1286 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1287 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1288 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1289 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1290 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1291 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1292 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1293 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1294 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1295 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1296 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 1249 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | Opt | 0.271 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | 0 | 0 |
| 1250 | 0 | 10 | 0 | 0 | 205.1 | 0.714 | Opt | 0.31 | 0 | 10 | 0 | 3 | 212.6 | 0.7017 | 0.01 | 0.03657 |
| 1251 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | Opt | 0.271 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | 0.01 | 0 |
| 1252 | 0 | 8 | 2 | 0 | 246.1 | 0.7059 | Opt | 0.29 | 0 | 7 | 3 | 0 | 266.6 | 0.7144 | 0 | 0.08326 |
| 1253 | 1 | 9 | 0 | 0 | 184.9 | 0.7276 | Opt | 0.271 | 1 | 9 | 0 | 0 | 184.9 | 0.7276 | 0 | 2.2E-05 |
| 1254 | 1 | 9 | 0 | 0 | 184.9 | 0.7231 | Opt | 0.27 | 1 | 9 | 0 | 0 | 184.9 | 0.7111 | 0 | 3.8E-05 |
| 1255 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | Opt | 0.28 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | 0 | 0 |
| 1256 | 0 | 10 | 0 | 0 | 205.2 | 0.7358 | Opt | 0.281 | 0 | 10 | 0 | 0 | 205.2 | 0.7242 | 0.01 | 1.5E-05 |
| 1257 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | Opt | 0.28 | 0 | 7 | 3 | 0 | 266.7 | 0.7084 | 0 | 0 |
| 1258 | 0 | 7 | 3 | 0 | 266.7 | 0.7088 | Opt | 0.281 | 0 | 7 | 3 | 1 | 269.2 | 0.7005 | 0 | 0.00938 |
| 1259 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | Opt | 0.27 | 0 | 6 | 4 | 0 | 287.2 | 0.7106 | 0 | 0 |
| 1260 | 0 | 6 | 4 | 0 | 287.2 | 0.7105 | Opt | 0.26 | 0 | 6 | 4 | 0 | 287.2 | 0.7016 | 0.01 | 1E-05 |
| 1261 | 0 | 8 | 2 | 0 | 246.4 | 0.7188 | Opt | 0.271 | 0 | 8 | 2 | 0 | 246.4 | 0.7188 | 0.01 | 0 |
| 1262 | 0 | 8 | 2 | 0 | 246.4 | 0.7182 | Opt | 0.29 | 0 | 8 | 2 | 0 | 246.4 | 0.7105 | 0 | 1.6E-05 |
| 1263 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | Opt | 0.311 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | 0 | 0 |
| 1264 | 0 | 7 | 3 | 0 | 266.9 | 0.7218 | Opt | 0.32 | 0 | 7 | 3 | 0 | 266.9 | 0.7144 | 0.01 | 1.1E-05 |
| 1265 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.26 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0.01 | 0 |
| 1266 | 0 | 9 | 1 | 1 | 228.1 | 0.7514 | Opt | 0.281 | 0 | 8 | 2 | 0 | 246.1 | 0.7577 | 0.01 | 0.07888 |
| 1267 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.26 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0.01 | 0 |
| 1268 | 0 | 6 | 4 | 0 | 287.1 | 0.7539 | Opt | 0.271 | 0 | 5 | 5 | 0 | 307.6 | 0.7593 | 0.01 | 0.07139 |
| 1269 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | Opt | 0.27 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | 0 | 0 |
| 1270 | 0 | 10 | 0 | 0 | 205.2 | 0.7871 | Opt | 0.27 | 0 | 10 | 0 | 0 | 205.2 | 0.774 | 0 | 1.5E-05 |
| 1271 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | Opt | 0.271 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | 0 | 0 |
| 1272 | 0 | 9 | 1 | 0 | 225.7 | 0.7608 | Opt | 0.31 | 0 | 9 | 1 | 2 | 230.7 | 0.7507 | 0.01 | 0.02216 |
| 1273 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | Opt | 0.271 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | 0.01 | 0 |
| 1274 | 0 | 6 | 4 | 1 | 289.7 | 0.7503 | Opt | 0.27 | 0 | 5 | 5 | 0 | 307.7 | 0.7757 | 0 | 0.06206 |
| 1275 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | Opt | 2.384 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | 0.01 | 0 |
| 1276 | 0 | 5 | 5 | 5 | 320.2 | 0.7501 | Opt | 1.251 | 0 | 4 | 6 | 0 | 328.2 | 0.7691 | 0.01 | 0.02492 |
| 1277 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | Opt | 0.271 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | 0 | 0 |
| 1278 | 0 | 7 | 3 | 0 | 266.8 | 0.7539 | Opt | 0.27 | 0 | 6 | 4 | 0 | 287.3 | 0.7795 | 0.01 | 0.07672 |
| 1279 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | Opt | 0.281 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | 0 | 0 |
| 1280 | 0 | 6 | 4 | 0 | 287.3 | 0.7544 | Opt | 0.28 | 0 | 5 | 5 | 0 | 307.8 | 0.7753 | 0 | 0.07124 |
| 1281 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | Opt | 0.27 | 0 | 10 | 0 | 0 | 205.1 | 0.7148 | 0 | 0 |
| 1282 | 0 | 10 | 0 | 0 | 205.1 | 0.714 | Opt | 0.351 | 0 | 10 | 0 | 3 | 212.6 | 0.7017 | 0 | 0.03656 |
| 1283 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | Opt | 0.28 | 0 | 8 | 2 | 0 | 246.1 | 0.7048 | 0 | 0 |
| 1284 | 0 | 8 | 2 | 0 | 246.1 | 0.7059 | Opt | 0.301 | 0 | 7 | 3 | 0 | 266.6 | 0.7144 | 0 | 0.08327 |
| 1285 | 1 | 9 | 0 | 0 | 184.8 | 0.7276 | Opt | 0.27 | 1 | 9 | 0 | 0 | 184.8 | 0.7276 | 0 | 1.1E-05 |
| 1286 | 1 | 9 | 0 | 0 | 184.8 | 0.7231 | Opt | 0.27 | 1 | 9 | 0 | 0 | 184.8 | 0.7111 | 0 | 2.2E-05 |
| 1287 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | Opt | 0.291 | 0 | 10 | 0 | 0 | 205.2 | 0.7378 | 0.01 | 0 |
| 1288 | 0 | 10 | 0 | 0 | 205.2 | 0.7358 | Opt | 0.27 | 0 | 10 | 0 | 0 | 205.2 | 0.7242 | 0 | 9.7E-06 |
| 1289 | 0 | 7 | 3 | 0 | 266.8 | 0.7084 | Opt | 0.281 | 0 | 7 | 3 | 0 | 266.8 | 0.7084 | 0.01 | 0 |
| 1290 | 0 | 7 | 3 | 0 | 266.8 | 0.7088 | Opt | 0.27 | 0 | 7 | 3 | 1 | 269.3 | 0.7005 | 0.01 | 0.00938 |
| 1291 | 0 | 6 | 4 | 0 | 287.3 | 0.7106 | Opt | 0.281 | 0 | 6 | 4 | 0 | 287.3 | 0.7106 | 0 | 0 |
| 1292 | 0 | 6 | 4 | 0 | 287.3 | 0.7105 | Opt | 0.27 | 0 | 6 | 4 | 0 | 287.3 | 0.7016 | 0 | 3.5E-06 |
| 1293 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | Opt | 0.27 | 0 | 8 | 2 | 0 | 246.3 | 0.7188 | 0.01 | 0 |
| 1294 | 0 | 8 | 2 | 0 | 246.4 | 0.7182 | Opt | 0.281 | 0 | 8 | 2 | 0 | 246.4 | 0.7105 | 0 | 8.1E-06 |
| 1295 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | Opt | 0.31 | 0 | 7 | 3 | 0 | 266.8 | 0.7222 | 0.01 | 0 |
| 1296 | 0 | 7 | 3 | 0 | 266.9 | 0.7218 | Opt | 0.371 | 0 | 7 | 3 | 0 | 266.9 | 0.7144 | 0.01 | 3.7E-06 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1297 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1298 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1299 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1300 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1301 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1302 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1303 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1304 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1305 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1306 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1307 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1308 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1309 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1310 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1311 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1312 | 20 | 2 | 0.5 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1313 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1314 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1315 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1316 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1317 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1318 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1319 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1320 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1321 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1322 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1323 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1324 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1325 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1326 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1327 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1328 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1329 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1330 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1331 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1332 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1333 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1334 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1335 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1336 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1337 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1338 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1339 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1340 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1341 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1342 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1343 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1344 | 20 | 2 | 0.5 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 1297 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.28 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0 | 0 |
| 1298 | 0 | 9 | 1 | 1 | 228.1 | 0.7514 | Opt | 0.291 | 0 | 8 | 2 | 0 | 246.1 | 0.7577 | 0 | 0.07889 |
| 1299 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.28 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0 | 0 |
| 1300 | 0 | 6 | 4 | 0 | 287.1 | 0.7539 | Opt | 0.28 | 0 | 5 | 5 | 0 | 307.6 | 0.7593 | 0 | 0.07139 |
| 1301 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | Opt | 0.281 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | 0 | 0 |
| 1302 | 0 | 10 | 0 | 0 | 205.2 | 0.7871 | Opt | 0.28 | 0 | 10 | 0 | 0 | 205.2 | 0.774 | 0 | 9.7E-06 |
| 1303 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | Opt | 0.271 | 0 | 9 | 1 | 0 | 225.7 | 0.7631 | 0 | 0 |
| 1304 | 0 | 9 | 1 | 0 | 225.7 | 0.7608 | Opt | 0.33 | 0 | 9 | 1 | 2 | 230.7 | 0.7507 | 0.01 | 0.02216 |
| 1305 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | Opt | 0.27 | 0 | 6 | 4 | 0 | 287.2 | 0.7508 | 0 | 0 |
| 1306 | 0 | 6 | 4 | 1 | 289.7 | 0.7503 | Opt | 0.281 | 0 | 5 | 5 | 0 | 307.7 | 0.7757 | 0.01 | 0.06209 |
| 1307 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | Opt | 2.974 | 0 | 4 | 6 | 0 | 328.2 | 0.7809 | 0.01 | 0 |
| 1308 | 0 | 5 | 5 | 5 | 320.3 | 0.7501 | Opt | 0.451 | 0 | 4 | 6 | 0 | 328.2 | 0.7691 | 0 | 0.02495 |
| 1309 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | Opt | 0.27 | 0 | 7 | 3 | 0 | 266.8 | 0.755 | 0 | 0 |
| 1310 | 0 | 7 | 3 | 0 | 266.8 | 0.7539 | Opt | 0.271 | 0 | 6 | 4 | 0 | 287.3 | 0.7795 | 0.01 | 0.07677 |
| 1311 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | Opt | 0.28 | 0 | 6 | 4 | 0 | 287.3 | 0.7558 | 0.01 | 0 |
| 1312 | 0 | 6 | 4 | 0 | 287.3 | 0.7544 | Opt | 0.27 | 0 | 5 | 5 | 0 | 307.8 | 0.7753 | 0 | 0.0713 |
| 1313 | 0 | 10 | 0 | 0 | 205.2 | 0.7148 | Opt | 0.281 | 0 | 10 | 0 | 0 | 205.2 | 0.7148 | 0.01 | 0 |
| 1314 | 0 | 10 | 0 | 0 | 205.2 | 0.714 | Opt | 0.32 | 0 | 10 | 0 | 3 | 212.7 | 0.7017 | 0 | 0.03656 |
| 1315 | 0 | 8 | 2 | 0 | 246.2 | 0.7048 | Opt | 0.281 | 0 | 8 | 2 | 0 | 246.2 | 0.7048 | 0 | 0 |
| 1316 | 0 | 8 | 2 | 0 | 246.2 | 0.7059 | Opt | 0.3 | 0 | 7 | 3 | 0 | 266.7 | 0.7144 | 0.01 | 0.08325 |
| 1317 | 1 | 9 | 0 | 0 | 185 | 0.7276 | Opt | 0.28 | 1 | 9 | 0 | 0 | 185 | 0.7276 | 0 | 2.2E-05 |
| 1318 | 1 | 9 | 0 | 0 | 185 | 0.7231 | Opt | 0.281 | 1 | 9 | 0 | 0 | 185 | 0.7111 | 0 | 3.8E-05 |
| 1319 | 0 | 10 | 0 | 0 | 205.3 | 0.7378 | Opt | 0.3 | 0 | 10 | 0 | 0 | 205.3 | 0.7378 | 0 | 0 |
| 1320 | 0 | 10 | 0 | 0 | 205.3 | 0.7358 | Opt | 0.291 | 0 | 10 | 0 | 0 | 205.3 | 0.7242 | 0 | 1.5E-05 |
| 1321 | 0 | 7 | 3 | 0 | 266.8 | 0.7084 | Opt | 0.29 | 0 | 7 | 3 | 0 | 266.8 | 0.7084 | 0 | 0 |
| 1322 | 0 | 7 | 3 | 0 | 266.8 | 0.7088 | Opt | 0.271 | 0 | 7 | 3 | 1 | 269.3 | 0.7005 | 0.01 | 0.00938 |
| 1323 | 0 | 6 | 4 | 0 | 287.3 | 0.7106 | Opt | 0.28 | 0 | 6 | 4 | 0 | 287.3 | 0.7106 | 0.01 | 0 |
| 1324 | 0 | 6 | 4 | 0 | 287.3 | 0.7105 | Opt | 0.28 | 0 | 6 | 4 | 0 | 287.3 | 0.7016 | 0 | 7E-06 |
| 1325 | 0 | 8 | 2 | 0 | 246.4 | 0.7188 | Opt | 0.281 | 0 | 8 | 2 | 0 | 246.4 | 0.7188 | 0.01 | 0 |
| 1326 | 0 | 8 | 2 | 0 | 246.5 | 0.7182 | Opt | 0.29 | 0 | 8 | 2 | 0 | 246.5 | 0.7105 | 0 | 1.6E-05 |
| 1327 | 0 | 7 | 3 | 0 | 266.9 | 0.7222 | Opt | 0.321 | 0 | 7 | 3 | 0 | 266.9 | 0.7222 | 0 | 0 |
| 1328 | 0 | 7 | 3 | 0 | 266.9 | 0.7218 | Opt | 0.29 | 0 | 7 | 3 | 0 | 267 | 0.7144 | 0 | 1.5E-05 |
| 1329 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | Opt | 0.271 | 0 | 9 | 1 | 0 | 225.6 | 0.7515 | 0.01 | 0 |
| 1330 | 0 | 9 | 1 | 1 | 228.2 | 0.7514 | Opt | 0.29 | 0 | 8 | 2 | 0 | 246.2 | 0.7577 | 0.01 | 0.07887 |
| 1331 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | Opt | 0.28 | 0 | 6 | 4 | 0 | 287.1 | 0.7541 | 0 | 0 |
| 1332 | 0 | 6 | 4 | 0 | 287.2 | 0.7539 | Opt | 0.281 | 0 | 5 | 5 | 0 | 307.7 | 0.7593 | 0 | 0.07138 |
| 1333 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | Opt | 0.28 | 0 | 10 | 0 | 0 | 205.2 | 0.7911 | 0.01 | 0 |
| 1334 | 0 | 10 | 0 | 0 | 205.3 | 0.7871 | Opt | 0.281 | 0 | 10 | 0 | 0 | 205.3 | 0.774 | 0 | 1.9E-05 |
| 1335 | 0 | 9 | 1 | 0 | 225.8 | 0.7631 | Opt | 0.28 | 0 | 9 | 1 | 0 | 225.8 | 0.7631 | 0.01 | 0 |
| 1336 | 0 | 9 | 1 | 0 | 225.8 | 0.7608 | Opt | 0.33 | 0 | 9 | 1 | 2 | 230.8 | 0.7507 | 0 | 0.02215 |
| 1337 | 0 | 6 | 4 | 0 | 287.3 | 0.7508 | Opt | 0.281 | 0 | 6 | 4 | 0 | 287.3 | 0.7508 | 0 | 0 |
| 1338 | 0 | 6 | 4 | 1 | 289.8 | 0.7503 | Opt | 0.29 | 0 | 5 | 5 | 0 | 307.8 | 0.7757 | 0.01 | 0.06205 |
| 1339 | 0 | 4 | 6 | 0 | 328.3 | 0.7809 | Opt | 2.384 | 0 | 4 | 6 | 0 | 328.3 | 0.7809 | 0 | 0 |
| 1340 | 0 | 5 | 5 | 5 | 320.3 | 0.7501 | Opt | 0.44 | 0 | 4 | 6 | 0 | 328.3 | 0.7691 | 0.01 | 0.02493 |
| 1341 | 0 | 7 | 3 | 0 | 266.9 | 0.755 | Opt | 0.281 | 0 | 7 | 3 | 0 | 266.9 | 0.755 | 0 | 0 |
| 1342 | 0 | 7 | 3 | 0 | 266.9 | 0.7539 | Opt | 0.28 | 0 | 6 | 4 | 0 | 287.4 | 0.7795 | 0 | 0.07671 |
| 1343 | 0 | 6 | 4 | 0 | 287.4 | 0.7558 | Opt | 0.291 | 0 | 6 | 4 | 0 | 287.4 | 0.7558 | 0 | 0 |
| 1344 | 0 | 6 | 4 | 0 | 287.4 | 0.7544 | Opt | 0.28 | 0 | 5 | 5 | 0 | 307.9 | 0.7753 | 0.01 | 0.07123 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1345 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1346 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1347 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1348 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1349 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1350 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1351 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1352 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1353 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1354 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1355 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1356 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1357 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1358 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1359 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1360 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1361 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1362 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1363 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1364 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1365 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1366 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1367 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1368 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1369 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1370 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1371 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1372 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1373 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1374 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1375 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1376 | 20 | 2 | 1 | 0.05 | 0.075 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1377 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1378 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1379 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1380 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1381 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1382 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1383 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1384 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1385 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1386 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1387 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1388 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1389 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1390 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1391 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1392 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 1345 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | Opt | 0.28 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | 0 | 0 |
| 1346 | 0 | 10 | 0 | 0 | 210.1 | 0.714 | Opt | 0.331 | 0 | 10 | 0 | 3 | 219.1 | 0.7017 | 0 | 0.04285 |
| 1347 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | Opt | 0.28 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | 0.01 | 0 |
| 1348 | 0 | 8 | 2 | 0 | 252.1 | 0.7059 | Opt | 0.301 | 0 | 7 | 3 | 0 | 273.1 | 0.7144 | 0 | 0.08329 |
| 1349 | 1 | 9 | 0 | 0 | 189.2 | 0.7276 | Opt | 0.28 | 1 | 9 | 0 | 0 | 189.2 | 0.7276 | 0 | 1.1E-05 |
| 1350 | 1 | 9 | 0 | 0 | 189.2 | 0.7231 | Opt | 0.271 | 1 | 9 | 0 | 0 | 189.2 | 0.7111 | 0.01 | 1.6E-05 |
| 1351 | 0 | 10 | 0 | 0 | 210.1 | 0.7378 | Opt | 0.3 | 0 | 10 | 0 | 0 | 210.1 | 0.7378 | 0.01 | 0 |
| 1352 | 0 | 10 | 0 | 0 | 210.1 | 0.7358 | Opt | 0.28 | 0 | 10 | 0 | 0 | 210.1 | 0.7242 | 0 | 9.5E-06 |
| 1353 | 0 | 7 | 3 | 0 | 273.1 | 0.7084 | Opt | 0.291 | 0 | 7 | 3 | 0 | 273.1 | 0.7084 | 0.01 | 0 |
| 1354 | 0 | 7 | 3 | 0 | 273.2 | 0.7088 | Opt | 0.3 | 0 | 7 | 3 | 1 | 276.2 | 0.7005 | 0 | 0.01098 |
| 1355 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | Opt | 0.281 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | 0 | 0 |
| 1356 | 0 | 6 | 4 | 0 | 294.2 | 0.7105 | Opt | 0.31 | 0 | 6 | 4 | 0 | 294.2 | 0.7016 | 0.01 | 3.4E-06 |
| 1357 | 0 | 8 | 2 | 0 | 252.2 | 0.7188 | Opt | 0.281 | 0 | 8 | 2 | 0 | 252.2 | 0.7188 | 0 | 0 |
| 1358 | 0 | 8 | 2 | 0 | 252.2 | 0.7159 | Opt | 0.3 | 0 | 8 | 2 | 0 | 252.2 | 0.7105 | 0.01 | 1.2E-05 |
| 1359 | 0 | 7 | 3 | 0 | 273.2 | 0.7222 | Opt | 0.32 | 0 | 7 | 3 | 0 | 273.2 | 0.7222 | 0 | 0 |
| 1360 | 0 | 7 | 3 | 0 | 273.2 | 0.7218 | Opt | 0.311 | 0 | 7 | 3 | 0 | 273.2 | 0.7144 | 0 | 7.3E-06 |
| 1361 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.28 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0 | 0 |
| 1362 | 0 | 9 | 1 | 1 | 234.1 | 0.7514 | Opt | 0.301 | 0 | 8 | 2 | 0 | 252.1 | 0.7577 | 0.01 | 0.07689 |
| 1363 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.28 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0 | 0 |
| 1364 | 0 | 6 | 4 | 0 | 294.1 | 0.7539 | Opt | 0.291 | 0 | 5 | 5 | 0 | 315.1 | 0.7593 | 0 | 0.0714 |
| 1365 | 0 | 10 | 0 | 0 | 210.1 | 0.7911 | Opt | 0.3 | 0 | 10 | 0 | 0 | 210.1 | 0.7911 | 0 | 0 |
| 1366 | 0 | 10 | 0 | 0 | 210.1 | 0.7871 | Opt | 0.29 | 0 | 10 | 0 | 0 | 210.1 | 0.774 | 0 | 9.5E-06 |
| 1367 | 0 | 9 | 1 | 0 | 231.1 | 0.7631 | Opt | 0.291 | 0 | 9 | 1 | 0 | 231.1 | 0.7631 | 0 | 0 |
| 1368 | 0 | 9 | 1 | 0 | 231.1 | 0.7608 | Opt | 0.31 | 0 | 9 | 1 | 2 | 237.1 | 0.7507 | 0 | 0.02596 |
| 1369 | 0 | 6 | 4 | 0 | 294.1 | 0.7508 | Opt | 0.281 | 0 | 6 | 4 | 0 | 294.1 | 0.7508 | 0.01 | 0 |
| 1370 | 0 | 6 | 4 | 1 | 297.1 | 0.7503 | Opt | 0.3 | 0 | 5 | 5 | 0 | 315.1 | 0.7757 | 0 | 0.06055 |
| 1371 | 0 | 4 | 6 | 0 | 336.1 | 0.7809 | Opt | 0.551 | 0 | 4 | 6 | 0 | 336.1 | 0.7809 | 0 | 0 |
| 1372 | 0 | 5 | 5 | 5 | 330.1 | 0.7501 | Opt | 0.471 | 0 | 4 | 6 | 0 | 336.1 | 0.7691 | 0.01 | 0.01815 |
| 1373 | 0 | 7 | 3 | 0 | 273.2 | 0.755 | Opt | 0.29 | 0 | 7 | 3 | 0 | 273.2 | 0.755 | 0.01 | 0 |
| 1374 | 0 | 7 | 3 | 0 | 273.2 | 0.7539 | Opt | 0.29 | 0 | 6 | 4 | 0 | 294.2 | 0.7795 | 0 | 0.07682 |
| 1375 | 0 | 6 | 4 | 0 | 294.2 | 0.7558 | Opt | 0.291 | 0 | 6 | 4 | 0 | 294.2 | 0.7558 | 0 | 0 |
| 1376 | 0 | 6 | 4 | 0 | 294.2 | 0.7544 | Opt | 0.29 | 0 | 5 | 5 | 0 | 315.2 | 0.7753 | 0.01 | 0.07133 |
| 1377 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | Opt | 0.281 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | 0 | 0 |
| 1378 | 0 | 10 | 0 | 0 | 210.1 | 0.714 | Opt | 0.33 | 0 | 10 | 0 | 3 | 219.1 | 0.7017 | 0.01 | 0.04284 |
| 1379 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | Opt | 0.291 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | 0 | 0 |
| 1380 | 0 | 8 | 2 | 0 | 252.1 | 0.7059 | Opt | 0.29 | 0 | 7 | 3 | 0 | 273.1 | 0.7144 | 0 | 0.08327 |
| 1381 | 1 | 9 | 0 | 0 | 189.4 | 0.7276 | Opt | 0.28 | 1 | 9 | 0 | 0 | 189.4 | 0.7276 | 0.01 | 2.1E-05 |
| 1382 | 1 | 9 | 0 | 0 | 189.4 | 0.7231 | Opt | 0.291 | 1 | 9 | 0 | 0 | 189.4 | 0.7111 | 0 | 3.7E-05 |
| 1383 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | Opt | 0.3 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | 0.01 | 0 |
| 1384 | 0 | 10 | 0 | 0 | 210.2 | 0.7358 | Opt | 0.301 | 0 | 10 | 0 | 0 | 210.2 | 0.7242 | 0 | 1.4E-05 |
| 1385 | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | Opt | 0.3 | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | 0 | 0 |
| 1386 | 0 | 7 | 3 | 0 | 273.2 | 0.7088 | Opt | 0.301 | 0 | 7 | 3 | 1 | 276.2 | 0.7005 | 0 | 0.01099 |
| 1387 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | Opt | 0.29 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | 0 | 0 |
| 1388 | 0 | 6 | 4 | 0 | 294.2 | 0.7105 | Opt | 0.3 | 0 | 6 | 4 | 0 | 294.2 | 0.7016 | 0 | 6.8E-06 |
| 1389 | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | Opt | 0.291 | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | 0 | 0 |
| 1390 | 0 | 8 | 2 | 0 | 252.3 | 0.7182 | Opt | 0.29 | 0 | 8 | 2 | 0 | 252.3 | 0.7105 | 0 | 1.6E-05 |
| 1391 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | Opt | 0.301 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | 0.01 | 0 |
| 1392 | 0 | 7 | 3 | 0 | 273.3 | 0.7218 | Opt | 0.31 | 0 | 7 | 3 | 0 | 273.3 | 0.7144 | 0 | 1.5E-05 |

| | Input Parameters | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1393 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1394 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1395 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1396 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1397 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1398 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1399 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1400 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1401 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1402 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1403 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1404 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1405 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1406 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1407 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1408 | 20 | 2 | 1 | 0.05 | 0.075 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1409 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1410 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1411 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1412 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1413 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1414 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1415 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1416 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1417 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1418 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1419 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1420 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1421 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1422 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1423 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1424 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1425 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1426 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1427 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1428 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1429 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1430 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1431 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1432 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1433 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1434 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1435 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1436 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1437 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1438 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1439 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1440 | 20 | 2 | 1 | 0.05 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 1393 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.281 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0.01 | 0 |
| 1394 | 0 | 9 | 1 | 1 | 234.1 | 0.7514 | Opt | 0.3 | 0 | 8 | 2 | 0 | 252.1 | 0.7577 | 0.01 | 0.07687 |
| 1395 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.29 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0 | 0 |
| 1396 | 0 | 6 | 4 | 0 | 294.1 | 0.7539 | Opt | 0.291 | 0 | 5 | 5 | 0 | 315.1 | 0.7593 | 0 | 0.0714 |
| 1397 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | Opt | 0.3 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | 0.01 | 0 |
| 1398 | 0 | 10 | 0 | 0 | 210.2 | 0.7871 | Opt | 0.281 | 0 | 10 | 0 | 0 | 210.2 | 0.774 | 0.01 | 1.9E-05 |
| 1399 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | Opt | 0.28 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | 0.01 | 0 |
| 1400 | 0 | 9 | 1 | 0 | 231.2 | 0.7608 | Opt | 0.321 | 0 | 9 | 1 | 2 | 237.2 | 0.7507 | 0.01 | 0.02597 |
| 1401 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | Opt | 0.29 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | 0 | 0 |
| 1402 | 0 | 6 | 4 | 1 | 297.2 | 0.7503 | Opt | 0.301 | 0 | 5 | 5 | 0 | 315.2 | 0.7757 | 0 | 0.06051 |
| 1403 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | Opt | 7.05 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | 0 | 0 |
| 1404 | 0 | 5 | 5 | 5 | 330.2 | 0.75 | Opt | 2.003 | 0 | 4 | 6 | 0 | 336.2 | 0.7691 | 0.01 | 0.01813 |
| 1405 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | Opt | 0.29 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | 0 | 0 |
| 1406 | 0 | 7 | 3 | 0 | 273.3 | 0.7539 | Opt | 0.29 | 0 | 6 | 4 | 0 | 294.3 | 0.7795 | 0.01 | 0.07675 |
| 1407 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | Opt | 0.291 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | 0 | 0 |
| 1408 | 0 | 6 | 4 | 0 | 294.3 | 0.7544 | Opt | 0.29 | 0 | 5 | 5 | 0 | 315.3 | 0.7753 | 0.01 | 0.07127 |
| 1409 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | Opt | 0.291 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | 0.01 | 0 |
| 1410 | 0 | 10 | 0 | 0 | 210.1 | 0.714 | Opt | 0.33 | 0 | 10 | 0 | 3 | 219.1 | 0.7017 | 0 | 0.04284 |
| 1411 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | Opt | 0.291 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | 0 | 0 |
| 1412 | 0 | 8 | 2 | 0 | 252.1 | 0.7059 | Opt | 0.29 | 0 | 7 | 3 | 0 | 273.1 | 0.7144 | 0.01 | 0.08328 |
| 1413 | 1 | 9 | 0 | 0 | 189.2 | 0.7276 | Opt | 0.29 | 1 | 9 | 0 | 0 | 189.2 | 0.7276 | 0 | 1.1E-05 |
| 1414 | 1 | 9 | 0 | 0 | 189.3 | 0.7231 | Opt | 0.291 | 1 | 9 | 0 | 0 | 189.3 | 0.7111 | 0 | 1.6E-05 |
| 1415 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | Opt | 0.29 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | 0.01 | 0 |
| 1416 | 0 | 10 | 0 | 0 | 210.2 | 0.7358 | Opt | 0.301 | 0 | 10 | 0 | 0 | 210.2 | 0.7242 | 0 | 9.5E-06 |
| 1417 | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | Opt | 0.31 | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | 0 | 0 |
| 1418 | 0 | 7 | 3 | 0 | 273.2 | 0.7088 | Opt | 0.311 | 0 | 7 | 3 | 1 | 276.2 | 0.7005 | 0 | 0.01098 |
| 1419 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | Opt | 0.31 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | 0 | 0 |
| 1420 | 0 | 6 | 4 | 0 | 294.2 | 0.7105 | Opt | 0.31 | 0 | 6 | 4 | 0 | 294.2 | 0.7016 | 0 | 3.4E-06 |
| 1421 | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | Opt | 0.301 | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | 0 | 0 |
| 1422 | 0 | 8 | 2 | 0 | 252.3 | 0.7182 | Opt | 0.3 | 0 | 8 | 2 | 0 | 252.3 | 0.7105 | 0 | 7.9E-06 |
| 1423 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | Opt | 0.321 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | 0.01 | 0 |
| 1424 | 0 | 7 | 3 | 0 | 273.3 | 0.7218 | Opt | 0.37 | 0 | 7 | 3 | 0 | 273.3 | 0.7144 | 0.01 | 7.3E-06 |
| 1425 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.291 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0.01 | 0 |
| 1426 | 0 | 9 | 1 | 1 | 234.1 | 0.7514 | Opt | 0.31 | 0 | 8 | 2 | 0 | 252.1 | 0.7577 | 0 | 0.07687 |
| 1427 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.291 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0 | 0 |
| 1428 | 0 | 6 | 4 | 0 | 294.1 | 0.7539 | Opt | 0.3 | 0 | 5 | 5 | 0 | 315.1 | 0.7593 | 0 | 0.07139 |
| 1429 | 0 | 10 | 0 | 0 | 210.1 | 0.7911 | Opt | 0.291 | 0 | 10 | 0 | 0 | 210.1 | 0.7911 | 0 | 0 |
| 1430 | 0 | 10 | 0 | 0 | 210.2 | 0.7871 | Opt | 0.29 | 0 | 10 | 0 | 0 | 210.2 | 0.774 | 0.01 | 4.8E-06 |
| 1431 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | Opt | 0.29 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | 0.01 | 0 |
| 1432 | 0 | 9 | 1 | 0 | 231.2 | 0.7608 | Opt | 0.321 | 0 | 9 | 1 | 2 | 237.2 | 0.7507 | 0 | 0.02596 |
| 1433 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | Opt | 0.29 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | 0 | 0 |
| 1434 | 0 | 6 | 4 | 1 | 297.2 | 0.7503 | Opt | 0.301 | 0 | 5 | 5 | 0 | 315.2 | 0.7757 | 0.01 | 0.06052 |
| 1435 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | Opt | 1.482 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | 0.01 | 0 |
| 1436 | 0 | 5 | 5 | 5 | 330.2 | 0.7501 | Opt | 0.881 | 0 | 4 | 6 | 0 | 336.2 | 0.7691 | 0 | 0.01814 |
| 1437 | 0 | 7 | 3 | 0 | 273.2 | 0.755 | Opt | 0.301 | 0 | 7 | 3 | 0 | 273.2 | 0.755 | 0 | 0 |
| 1438 | 0 | 7 | 3 | 0 | 273.2 | 0.7539 | Opt | 0.29 | 0 | 6 | 4 | 0 | 294.2 | 0.7795 | 0.01 | 0.07679 |
| 1439 | 0 | 6 | 4 | 0 | 294.2 | 0.7558 | Opt | 0.3 | 0 | 6 | 4 | 0 | 294.2 | 0.7558 | 0 | 0 |
| 1440 | 0 | 6 | 4 | 0 | 294.2 | 0.7544 | Opt | 0.301 | 0 | 5 | 5 | 0 | 315.2 | 0.7753 | 0 | 0.07131 |

| | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1441 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1442 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1443 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1444 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1445 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1446 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1447 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1448 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1449 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1450 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1451 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1452 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1453 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1454 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1455 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1456 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1457 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1458 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1459 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1460 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1461 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1462 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1463 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1464 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1465 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1466 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1467 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1468 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1469 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1470 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1471 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1472 | 20 | 2 | 1 | 0.05 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1473 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1474 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1475 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1476 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1477 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1478 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1479 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1480 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1481 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1482 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1483 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1484 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1485 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1486 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1487 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1488 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 1441 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | Opt | 0.3 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | 0 | 0 |
| 1442 | 0 | 10 | 0 | 0 | 210.1 | 0.714 | Opt | 0.341 | 0 | 10 | 0 | 3 | 219.1 | 0.7017 | 0 | 0.04284 |
| 1443 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | Opt | 0.3 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | 0 | 0 |
| 1444 | 0 | 8 | 2 | 0 | 252.1 | 0.7059 | Opt | 0.301 | 0 | 7 | 3 | 0 | 273.1 | 0.7144 | 0 | 0.08326 |
| 1445 | 1 | 9 | 0 | 0 | 189.4 | 0.7276 | Opt | 0.29 | 1 | 9 | 0 | 0 | 189.4 | 0.7276 | 0.01 | 2.1E-05 |
| 1446 | 1 | 9 | 0 | 0 | 189.4 | 0.7231 | Opt | 0.301 | 1 | 9 | 0 | 0 | 189.4 | 0.7111 | 0 | 3.7E-05 |
| 1447 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | Opt | 0.3 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | 0 | 0 |
| 1448 | 0 | 10 | 0 | 0 | 210.2 | 0.7358 | Opt | 0.3 | 0 | 10 | 0 | 0 | 210.2 | 0.7242 | 0 | 1.4E-05 |
| 1449 | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | Opt | 0.301 | 0 | 7 | 3 | 0 | 273.2 | 0.7084 | 0.01 | 0 |
| 1450 | 0 | 7 | 3 | 0 | 273.2 | 0.7088 | Opt | 0.3 | 0 | 7 | 3 | 1 | 276.2 | 0.7005 | 0 | 0.01099 |
| 1451 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | Opt | 0.291 | 0 | 6 | 4 | 0 | 294.2 | 0.7106 | 0.01 | 0 |
| 1452 | 0 | 6 | 4 | 0 | 294.2 | 0.7105 | Opt | 0.32 | 0 | 6 | 4 | 0 | 294.2 | 0.7016 | 0.01 | 1E-05 |
| 1453 | 0 | 8 | 2 | 0 | 252.4 | 0.7188 | Opt | 0.291 | 0 | 8 | 2 | 0 | 252.4 | 0.7188 | 0 | 0 |
| 1454 | 0 | 8 | 2 | 0 | 252.4 | 0.7182 | Opt | 0.31 | 0 | 8 | 2 | 0 | 252.4 | 0.7105 | 0.01 | 1.6E-05 |
| 1455 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | Opt | 0.31 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | 0 | 0 |
| 1456 | 0 | 7 | 3 | 0 | 273.4 | 0.7218 | Opt | 0.331 | 0 | 7 | 3 | 0 | 273.4 | 0.7144 | 0 | 1.1E-05 |
| 1457 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.29 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0.01 | 0 |
| 1458 | 0 | 9 | 1 | 1 | 234.1 | 0.7514 | Opt | 0.311 | 0 | 8 | 2 | 0 | 252.1 | 0.7577 | 0.01 | 0.07685 |
| 1459 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.3 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0 | 0 |
| 1460 | 0 | 6 | 4 | 0 | 294.1 | 0.7539 | Opt | 0.301 | 0 | 5 | 5 | 0 | 315.1 | 0.7593 | 0 | 0.07139 |
| 1461 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | Opt | 0.3 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | 0 | 0 |
| 1462 | 0 | 10 | 0 | 0 | 210.2 | 0.7871 | Opt | 0.301 | 0 | 10 | 0 | 0 | 210.2 | 0.774 | 0.01 | 1.4E-05 |
| 1463 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | Opt | 0.3 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | 0 | 0 |
| 1464 | 0 | 9 | 1 | 0 | 231.2 | 0.7608 | Opt | 0.33 | 0 | 9 | 1 | 2 | 237.2 | 0.7507 | 0 | 0.02596 |
| 1465 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | Opt | 0.301 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | 0 | 0 |
| 1466 | 0 | 6 | 4 | 1 | 297.2 | 0.7503 | Opt | 0.31 | 0 | 5 | 5 | 0 | 315.2 | 0.7757 | 0 | 0.06049 |
| 1467 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | Opt | 0.511 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | 0.01 | 0 |
| 1468 | 0 | 5 | 5 | 5 | 330.2 | 0.7501 | Opt | 0.541 | 0 | 4 | 6 | 0 | 336.2 | 0.7691 | 0 | 0.01811 |
| 1469 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | Opt | 0.3 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | 0.01 | 0 |
| 1470 | 0 | 7 | 3 | 0 | 273.3 | 0.7539 | Opt | 0.301 | 0 | 6 | 4 | 0 | 294.3 | 0.7795 | 0 | 0.07672 |
| 1471 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | Opt | 0.3 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | 0 | 0 |
| 1472 | 0 | 6 | 4 | 0 | 294.3 | 0.7544 | Opt | 0.301 | 0 | 5 | 5 | 0 | 315.3 | 0.7753 | 0.01 | 0.07125 |
| 1473 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | Opt | 0.3 | 0 | 10 | 0 | 0 | 210.1 | 0.7148 | 0 | 0 |
| 1474 | 0 | 10 | 0 | 0 | 210.1 | 0.714 | Opt | 0.361 | 0 | 10 | 0 | 3 | 219.1 | 0.7017 | 0 | 0.04283 |
| 1475 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | Opt | 0.3 | 0 | 8 | 2 | 0 | 252.1 | 0.7048 | 0 | 0 |
| 1476 | 0 | 8 | 2 | 0 | 252.1 | 0.7059 | Opt | 0.31 | 0 | 7 | 3 | 0 | 273.1 | 0.7144 | 0 | 0.08327 |
| 1477 | 1 | 9 | 0 | 0 | 189.3 | 0.7276 | Opt | 0.301 | 1 | 9 | 0 | 0 | 189.3 | 0.7276 | 0 | 1.1E-05 |
| 1478 | 1 | 9 | 0 | 0 | 189.3 | 0.7231 | Opt | 0.3 | 1 | 9 | 0 | 0 | 189.3 | 0.7111 | 0.01 | 2.1E-05 |
| 1479 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | Opt | 0.311 | 0 | 10 | 0 | 0 | 210.2 | 0.7378 | 0 | 0 |
| 1480 | 0 | 10 | 0 | 0 | 210.2 | 0.7358 | Opt | 0.3 | 0 | 10 | 0 | 0 | 210.2 | 0.7242 | 0 | 9.5E-06 |
| 1481 | 0 | 7 | 3 | 0 | 273.3 | 0.7084 | Opt | 0.311 | 0 | 7 | 3 | 0 | 273.3 | 0.7084 | 0.01 | 0 |
| 1482 | 0 | 7 | 3 | 0 | 273.3 | 0.7088 | Opt | 0.32 | 0 | 7 | 3 | 1 | 276.3 | 0.7005 | 0 | 0.01098 |
| 1483 | 0 | 6 | 4 | 0 | 294.3 | 0.7106 | Opt | 0.311 | 0 | 6 | 4 | 0 | 294.3 | 0.7106 | 0 | 0 |
| 1484 | 0 | 6 | 4 | 0 | 294.3 | 0.7105 | Opt | 0.33 | 0 | 6 | 4 | 0 | 294.3 | 0.7016 | 0 | 3.4E-06 |
| 1485 | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | Opt | 0.301 | 0 | 8 | 2 | 0 | 252.3 | 0.7188 | 0 | 0 |
| 1486 | 0 | 8 | 2 | 0 | 252.4 | 0.7159 | Opt | 0.32 | 0 | 8 | 2 | 0 | 252.4 | 0.7105 | 0 | 7.9E-06 |
| 1487 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | Opt | 0.33 | 0 | 7 | 3 | 0 | 273.3 | 0.7222 | 0.01 | 0 |
| 1488 | 0 | 7 | 3 | 0 | 273.4 | 0.7218 | Opt | 0.331 | 0 | 7 | 3 | 0 | 273.4 | 0.7144 | 0.01 | 3.7E-06 |

| Exp # | Input Parameters | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $f$ | $\hat{f}$ | $h$ | $c^{in}$ | $c^{out}$ | $c^{e}$ | $\alpha$ | $d_1, d_2$ | $d_0$ | $d_{-1}$ | $\hat{d}$ |
| 1489 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1490 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1491 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1492 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1493 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1494 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1495 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1496 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1497 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1498 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1499 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1500 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1501 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1502 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1503 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1504 | 20 | 2 | 1 | 0.1 | 0.15 | 1 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1505 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1506 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1507 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1508 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1509 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1510 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1511 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1512 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1513 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1514 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1515 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1516 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1517 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1518 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1519 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1520 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.7 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1521 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1522 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1523 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1524 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1525 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1526 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1527 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1528 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0,0.05] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |
| 1529 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0,0.001] |
| 1530 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0,0.01] | [0.001,0.002] |
| 1531 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0,0.001] |
| 1532 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0,0.05] | [0.01,0.02] | [0.001,0.002] |
| 1533 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0,0.001] |
| 1534 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0,0.01] | [0.001,0.002] |
| 1535 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0,0.001] |
| 1536 | 20 | 2 | 1 | 0.1 | 0.15 | 2 | 0.75 | [0.05,0.1] | [0.05,0.1] | [0.01,0.02] | [0.001,0.002] |

| | Output | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exp # | Opt (0,0) | Opt (1,0 | Opt (1,1 | Opt # ded | Opt cost | Opt service | Opt status | Opt solTime | H (0,0 | H (1,0 | H (1,1 | H # ded | H cost | H service | H solTime | H-Opt Gap |
| 1489 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.3 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0 | 0 |
| 1490 | 0 | 9 | 1 | 1 | 234.1 | 0.7514 | Opt | 0.311 | 0 | 8 | 2 | 0 | 252.1 | 0.7577 | 0.01 | 0.07687 |
| 1491 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.3 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0 | 0 |
| 1492 | 0 | 6 | 4 | 0 | 294.1 | 0.7539 | Opt | 0.301 | 0 | 5 | 5 | 0 | 315.1 | 0.7593 | 0.01 | 0.07139 |
| 1493 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | Opt | 0.31 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | 0 | 0 |
| 1494 | 0 | 10 | 0 | 0 | 210.2 | 0.7871 | Opt | 0.301 | 0 | 10 | 0 | 0 | 210.2 | 0.774 | 0.01 | 9.5E-06 |
| 1495 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | Opt | 0.31 | 0 | 9 | 1 | 0 | 231.2 | 0.7631 | 0 | 0 |
| 1496 | 0 | 9 | 1 | 0 | 231.2 | 0.7608 | Opt | 0.331 | 0 | 9 | 1 | 2 | 237.2 | 0.7507 | 0 | 0.02595 |
| 1497 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | Opt | 0.3 | 0 | 6 | 4 | 0 | 294.2 | 0.7508 | 0.01 | 0 |
| 1498 | 0 | 6 | 4 | 1 | 297.2 | 0.7503 | Opt | 0.32 | 0 | 5 | 5 | 0 | 315.2 | 0.7757 | 0.01 | 0.06053 |
| 1499 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | Opt | 0.581 | 0 | 4 | 6 | 0 | 336.2 | 0.7809 | 0 | 0 |
| 1500 | 0 | 5 | 5 | 5 | 330.3 | 0.7501 | Opt | 0.501 | 0 | 4 | 6 | 0 | 336.2 | 0.7691 | 0.01 | 0.01814 |
| 1501 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | Opt | 0.31 | 0 | 7 | 3 | 0 | 273.3 | 0.755 | 0 | 0 |
| 1502 | 0 | 7 | 3 | 0 | 273.3 | 0.7539 | Opt | 0.3 | 0 | 6 | 4 | 0 | 294.3 | 0.7795 | 0.011 | 0.07678 |
| 1503 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | Opt | 0.31 | 0 | 6 | 4 | 0 | 294.3 | 0.7558 | 0.01 | 0 |
| 1504 | 0 | 6 | 4 | 0 | 294.3 | 0.7544 | Opt | 0.311 | 0 | 5 | 5 | 0 | 315.3 | 0.7753 | 0 | 0.0713 |
| 1505 | 0 | 10 | 0 | 0 | 210.2 | 0.7148 | Opt | 0.3 | 0 | 10 | 0 | 0 | 210.2 | 0.7148 | 0 | 0 |
| 1506 | 0 | 10 | 0 | 0 | 210.2 | 0.714 | Opt | 0.361 | 0 | 10 | 0 | 3 | 219.2 | 0.7017 | 0.01 | 0.04283 |
| 1507 | 0 | 8 | 2 | 0 | 252.2 | 0.7048 | Opt | 0.3 | 0 | 8 | 2 | 0 | 252.2 | 0.7048 | 0.01 | 0 |
| 1508 | 0 | 8 | 2 | 0 | 252.2 | 0.7059 | Opt | 0.321 | 0 | 7 | 3 | 0 | 273.2 | 0.7144 | 0 | 0.08325 |
| 1509 | 1 | 9 | 0 | 0 | 189.5 | 0.7276 | Opt | 0.31 | 1 | 9 | 0 | 0 | 189.5 | 0.7276 | 0 | 2.1E-05 |
| 1510 | 1 | 9 | 0 | 0 | 189.5 | 0.7231 | Opt | 0.311 | 1 | 9 | 0 | 0 | 189.5 | 0.7111 | 0 | 3.7E-05 |
| 1511 | 0 | 10 | 0 | 0 | 210.3 | 0.7378 | Opt | 0.32 | 0 | 10 | 0 | 0 | 210.3 | 0.7378 | 0 | 0 |
| 1512 | 0 | 10 | 0 | 0 | 210.3 | 0.7358 | Opt | 0.311 | 0 | 10 | 0 | 0 | 210.3 | 0.7242 | 0 | 1.4E-05 |
| 1513 | 0 | 7 | 3 | 0 | 273.3 | 0.7084 | Opt | 0.31 | 0 | 7 | 3 | 0 | 273.3 | 0.7084 | 0.01 | 0 |
| 1514 | 0 | 7 | 3 | 0 | 273.3 | 0.7088 | Opt | 0.32 | 0 | 7 | 3 | 1 | 276.3 | 0.7005 | 0.01 | 0.01098 |
| 1515 | 0 | 6 | 4 | 0 | 294.3 | 0.7106 | Opt | 0.311 | 0 | 6 | 4 | 0 | 294.3 | 0.7106 | 0 | 0 |
| 1516 | 0 | 6 | 4 | 0 | 294.3 | 0.7105 | Opt | 0.33 | 0 | 6 | 4 | 0 | 294.3 | 0.7016 | 0 | 6.8E-06 |
| 1517 | 0 | 8 | 2 | 0 | 252.4 | 0.7188 | Opt | 0.311 | 0 | 8 | 2 | 0 | 252.4 | 0.7188 | 0 | 0 |
| 1518 | 0 | 8 | 2 | 0 | 252.5 | 0.7182 | Opt | 0.32 | 0 | 8 | 2 | 0 | 252.5 | 0.7105 | 0 | 1.6E-05 |
| 1519 | 0 | 7 | 3 | 0 | 273.4 | 0.7222 | Opt | 0.321 | 0 | 7 | 3 | 0 | 273.4 | 0.7222 | 0 | 0 |
| 1520 | 0 | 7 | 3 | 0 | 273.4 | 0.7218 | Opt | 0.33 | 0 | 7 | 3 | 0 | 273.5 | 0.7144 | 0 | 1.5E-05 |
| 1521 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | Opt | 0.301 | 0 | 9 | 1 | 0 | 231.1 | 0.7515 | 0.01 | 0 |
| 1522 | 0 | 9 | 1 | 1 | 234.2 | 0.7514 | Opt | 0.32 | 0 | 8 | 2 | 0 | 252.2 | 0.7577 | 0.01 | 0.07685 |
| 1523 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | Opt | 0.301 | 0 | 6 | 4 | 0 | 294.1 | 0.7541 | 0 | 0 |
| 1524 | 0 | 6 | 4 | 0 | 294.2 | 0.7539 | Opt | 0.3 | 0 | 5 | 5 | 0 | 315.2 | 0.7593 | 0.01 | 0.07138 |
| 1525 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | Opt | 0.32 | 0 | 10 | 0 | 0 | 210.2 | 0.7911 | 0.01 | 0 |
| 1526 | 0 | 10 | 0 | 0 | 210.3 | 0.7871 | Opt | 0.311 | 0 | 10 | 0 | 0 | 210.3 | 0.774 | 0 | 1.9E-05 |
| 1527 | 0 | 9 | 1 | 0 | 231.3 | 0.7631 | Opt | 0.3 | 0 | 9 | 1 | 0 | 231.3 | 0.7631 | 0.01 | 0 |
| 1528 | 0 | 9 | 1 | 0 | 231.3 | 0.7608 | Opt | 0.331 | 0 | 9 | 1 | 2 | 237.3 | 0.7507 | 0.01 | 0.02595 |
| 1529 | 0 | 6 | 4 | 0 | 294.3 | 0.7508 | Opt | 0.3 | 0 | 6 | 4 | 0 | 294.3 | 0.7508 | 0 | 0 |
| 1530 | 0 | 6 | 4 | 1 | 297.3 | 0.7503 | Opt | 0.321 | 0 | 5 | 5 | 0 | 315.3 | 0.7757 | 0.01 | 0.06049 |
| 1531 | 0 | 4 | 6 | 0 | 336.3 | 0.7809 | Opt | 7.26 | 0 | 4 | 6 | 0 | 336.3 | 0.7809 | 0 | 0 |
| 1532 | 0 | 5 | 5 | 5 | 330.3 | 0.7501 | Opt | 0.541 | 0 | 4 | 6 | 0 | 336.3 | 0.7691 | 0.01 | 0.01812 |
| 1533 | 0 | 7 | 3 | 0 | 273.4 | 0.755 | Opt | 0.31 | 0 | 7 | 3 | 0 | 273.4 | 0.755 | 0 | 0 |
| 1534 | 0 | 7 | 3 | 0 | 273.4 | 0.7539 | Opt | 0.311 | 0 | 6 | 4 | 0 | 294.4 | 0.7795 | 0 | 0.07671 |
| 1535 | 0 | 6 | 4 | 0 | 294.4 | 0.7558 | Opt | 0.31 | 0 | 6 | 4 | 0 | 294.4 | 0.7558 | 0 | 0 |
| 1536 | 0 | 6 | 4 | 0 | 294.4 | 0.7544 | Opt | 0.311 | 0 | 5 | 5 | 0 | 315.4 | 0.7753 | 0.01 | 0.07124 |

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# VITA

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